Engineering, Science, and Management War Training

Final Report

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FOREWORD

MORE THAN 1½ million men and women received special training during the period from October 9, 1940, to June 30, 1945, in short, intensive college-level courses designed to prepare for technical and scientific work in war industries. These courses were conducted by colleges and universities under the sponsorship of the U. S. Office of Education. The Federal Government expended nearly 60 million dollars to cover the actual costs incurred.

The mere size of this program makes it worthy of study by all persons interested in higher education. Any undertaking which could call forth such efforts on the part of the colleges, already heavily burdened with their regular work and with many other kinds of special war work, and which could enroll so many men and women, especially in wartime, must have contained important implications for the colleges, for education in general, and for the Nation.

Early in the spring of 1940 it became evident that the number of engineers and scientists who could be graduated from the Nation's colleges would be insufficient to meet the critical needs of national defense. A specialized type of training program was inaugurated to supplement the regular curricula of engineering colleges with short, intensive, college-level courses having as their objectives the preparation of trainees to perform specific industrial jobs, the retraining of graduate engineers to perform new or more specialized tasks needed in the defense effort, and the building up of a large supply of technicians, draftsmen, inspectors, testers, and engineering assistants. The program originally was intended to train only engineers and assistant engineers, but developments during the latter part of 1940 made it desirable to broaden its scope by the application of this type of training to the fields of physics, chemistry, and production supervision.

During the early days of the program, much thought was given to questions of the relationship which the Office of Education should maintain to the institutions participating in the training. Most of these institutions had never before conducted

courses for which the Federal Government paid the costs, and many of them were fearful that they would be subjected to an unwelcome domination by the Government. Under any other situation than national defense, it is likely that many of them would have declined the invitation to participate.

The Office decided early that so far as it could be done, consistent with the responsibility imposed upon the Office by law, the program should be administered by the colleges and universities themselves. It was not to be an Office program with which the institutions assisted, but a program of the institutions with which the Office assisted.

In following out this decision, the services of Dean A. A. Potter of Purdue University were procured to help map out the program before the first appropriation was obtained. He devoted the summer of 1940 to a study of the kind of program needed, and helped to formulate most of the basic principles and policies upon which the program operated throughout its life. He continued to serve as a consultant to the office until the program closed, and also served as Chairman of the National Advisory Committee. In this dual capacity he rendered valuable assistance.

The National Advisory Committee, composed of leading educators in the fields covered by the program, served most successfully during the life of the program. Its services were supplemented by those of the regional advisers, who acted individually in their respective regions and also as a group. Both groups were most helpful by providing extensive counsel from the field in the formation of general policies and administrative procedures. The Office of Education gratefully acknowledges the services of these two advisory groups.

While the faithful services of all staff members of the ESMWT program were responsible for whatever success was achieved, it is fitting to acknowledge especially the unusual competence of the two directors. Dean R. A. Seaton accepted the directorship when the program started, and served until June 30, 1942. Dean George W. Case succeeded Dean Seaton, and continued in office until the end of the program. Members of the Washington staff frequently expressed their belief that the exceptional executive ability and inspiring leadership of these two men, and of Dean Potter, were largely responsible for the unusual *esprit de corps* which prevailed throughout the ESMWT organization, both in the Washington office and in the participating institutions, and which was an important factor in the efficient operation of the program. These men in turn on many occasions expressed their deep appreciation of the inspiration and encouragement they

received from the understanding and support given them by Dr. Fred J. Kelly, chief of the Division of Higher Education.

The ESMWT program proved most effective in providing war industry with an increased flow of college-trained people who contributed greatly to the efficiency and productiveness of the industries served and thus greatly expedited the national war effort.

JOHN W. STUDEBAKER,
U. S. Commissioner of Education

INTRODUCTION

IT IS THE PURPOSE of this history to present a brief factual outline of the origin, development, principal operating characteristics, and general results of the college-level war training program conducted by colleges and universities under the sponsorship of the U. S. Office of Education between October 9, 1940, and June 30, 1945.

This program was founded upon an important and far-reaching fundamental policy concerning relationships between the Federal Government and educational institutions of higher learning. It was decided by the Office of Education in the formative stages of the program that it should be administered by the participating institutions themselves as far as possible—that it should be a program of the institutions with which the Office assisted, rather than an Office program with which the institutions assisted.

This fundamental policy led directly to most of the basic principles discussed in chapter I and to the resulting policies and procedures outlined in chapter III. To it is attributable in large measure the hearty cooperation of the colleges and universities in the program, without which its significant contribution to the war effort would not have been possible.

The program was originally established in the fall of 1940 under the name Engineering Defense Training (referred to in this history as EDT). During the fiscal year 1941–42 it was known as Engineering, Science, and Management Defense Training (referred to in this history as ESMDT). During the fiscal years 1942–43, 1943–44, and 1944–45, it was known as Engineering, Science, and Management War Training (referred to in this history as ESMWT-I, ESMWT-II, and ESMWT-III, respectively.) When reference is made to the program as a whole rather than to the program of one specific year, the program is designated simply as ESMWT.

Despite the three names indicated above, and the expansion of the program at the end of its first year into three additional fields, the entire program from 1940 through 1945 was essentially one continuous program, and this history treats it as such.

The history consists of two main parts and a bibliography. Part I is a narrative account of the program, why and how it was

developed, its general operating policies and procedures, its contribution to the war effort, and the permanent educational values resulting from its operations.

Part II is a technical section setting forth in greater detail the authorizations of Congress, the organization established to operate the program, and the general methods of administration employed, and outlining the principal appraisals made of the program during its life.

It is believed that the reading of part I will result in a reasonably accurate conception of the chief characteristics of the program, its general methods of operation, and the results obtained. Part II is intended for the reader who wishes more detailed information concerning certain features of the program.

For the benefit of any who may be interested in still further details of the program, a comprehensive historical collection of forms, manuals, organization charts and other administrative documents, minutes of meetings of advisory groups, releases from the Washington office, detailed statistical reports, appraisals of the program, and testimonial letters from industries served will be maintained in the U. S. Office of Education in Washington, or deposited by the Office in the Archives of the United States, where it will be available to persons desiring to secure more detailed information concerning the program than can be included in this history.

PART I

Part I

DEVELOPMENT, GENERAL POLICIES, AND RESULTS ATTAINED

Chapter I
BASIC PRINCIPLES

THE DEVELOPMENT of a human institution is greatly influenced by the fundamental philosophy upon which it is based. A sound underlying philosophy will, in general, result in a satisfactory set of basic principles, which, in turn, will lead to the development of adequate but not unduly restrictive administrative controls, a suitable division of authority and responsibility, and a workable set of procedures which will be readily accepted by all concerned. In order to understand and appreciate the purpose of various steps taken in the development of any human institution it is necessary to be familiar with its underlying philosophy and principles. This applies with special emphasis to the ESMWT program because of its magnitude, the rapidity with which it developed, the number and diversity of independent institutions which participated, and the variety of industries served. It therefore seems advisable to set forth in this chapter the basic principles upon which ESMWT was founded and which operated throughout its life.

SPECIFIC TRAINING FOR SPECIFIC NEEDS

The program was not intended to provide complete engineering, scientific, or business education, nor as a program of general cultural education, but rather to give specific, intensive training to meet specific and definitely determined needs of defense and war industries.

Professional engineers, chemists, physicists, and other specialists in the application of science to industry need a thorough education in the basic sciences and in the general principles and theories underlying the whole field of their specialization and related fields, because of the great diversity of services which they are called upon to render. The education necessary for such men involves in some cases as much as 7 or 8 years of college education. However, in all scientific professions there are tasks, ordinarily performed by college graduates, which can be accomplished satisfactorily by persons with a minimum of general education, but with specialized training for these particular tasks. Thus, men can be prepared through intensive training programs to perform well the specialized tasks of the draftsman, the laboratory technician, the inspector, the tester, and a number of other positions, without extensive preparation in basic sciences and with little or no education in related fields. Similarly, men with degrees in one field of engineering can, through intensive training, be quickly prepared to work effectively in other fields of engineering. As an example, a structural engineer can, through specialized training, quickly become competent as a stress analyst in the design of airplanes; or a

mechanical engineer can be quickly trained to handle effectively the work of an ordnance inspector.

The main objective of the program described in this history was to aid the defense program and war effort by training people for specific defense tasks, giving them only such instruction as was directly and immediately needed in the limited tasks to be performed. This principle presented many new problems to the colleges and called for some changes in their thinking and procedures.

A PROGRAM OF THE INSTITUTIONS

A fundamental policy underlying ESMWT was that it should be a program of the institutions in which the Office of Education assisted, rather than a program of the Office in which the institutions assisted; that it should be administered by the colleges and universities themselves so far as possible, consistent with the responsibility imposed upon the Office by law. This policy led directly to the basic principles of institutional responsibility and institutional autonomy, which are discussed in succeeding paragraphs.

INSTITUTIONAL RESPONSIBILITY FOR FINDING LOCAL TRAINING NEEDS

Each participating institution was to be given the responsibility of ascertaining local training needs and of developing courses to meet these needs. Although there were certain training needs common to the country as a whole, nevertheless it was recognized that each college had its own clientele with its own peculiar problems, and that the new training program, to be truly effective, must be designed individually by each institution to meet the special needs of its local war industries and Federal agencies. This principle also raised many problems to be faced by the colleges, not the least of which was that of securing adequate statements of needs from the industries and Federal agencies to be served.

INSTITUTIONAL AUTONOMY

It was considered extremely important that the greatest possible degree of autonomy be allowed each college, consistent with efficient operation and with sufficient Federal control to assure the expenditure of funds in accordance with the will of Congress. Those responsible for the formulation of original policies in the program were intimately acquainted with the technical and scientific colleges of the country and with their facilities and characteristics. They realized that each college possessed certain rights and privileges granted under its charter, and that it could render its maximum contribution to the war effort if these rights and privileges were

scrupulously preserved, and each institution given the greatest possible latitude in working out its own program in accordance with its established policies and procedures, with a minimum of Federal control.

COSTS TO BE PAID, BUT NO PROFIT

Participating institutions were not expected to realize a profit from the program, but were to be reimbursed for all proper costs incurred in organizing and conducting courses under the program. It was intended that reimbursement should cover all costs incurred by the institution by reason of the conduct of such courses which would not have been incurred had the courses not been given. Furthermore, because of the rather rigid budgetary control under which many institutions customarily operate, it was considered essential that means be found which would enable a participating institution to pay necessary operating expenses, such as salaries of teachers and other employees, without being compelled to draw on its institutional funds. This principle led directly to the establishment of the procedure of transmitting funds to participating institutions on the basis of approved course proposals prior to the completion of courses, with a subsequent refund by the institution of unused funds. This procedure, which will be discussed at greater length in chapters II and IV, is believed to be unique in federally-subsidized programs. It is probable that without it many institutions would have been unable to make the splendid contribution to the war effort which they did make under this program.

This procedure was later liberalized by the establishment of the Working Fund procedure, under which participating institutions could secure Federal funds in advance of the submission of course proposals, with the provision that all expenditures from such Working Fund must be approved in course proposals or budgets for regional coordination, and that all unused funds must be refunded by the institution.

REGIONAL COOPERATION NEEDED

It was evident that if the program as a whole were to make its maximum contribution to the war effort, some effective means of interinstitutional cooperation must be found in order to avoid unnecessary duplication of effort and to assure that in any locality the needs of war industries be served by the institutions best equipped and staffed to serve each specific need. A pooling of resources was called for among institutions serving the same locality, making necessary a degree of interinstitutional cooperation which in some cases had not previously been planned. The acceptance of this principle led to the establishment of the Regional Advisers and regional committees, which will be discussed in chapters II, III, and VII.

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U. S. OFFICE OF EDUCATION RESPONSIBLE TO CONGRESS

At the same time it was realized that the U. S. Office of Education as a Federal agency must assume the responsibility of making certain that funds dispersed for the conduct of courses be used in accordance with the will of Congress as expressed in the Act. This implied a direct contractual relationship between the Office and each individual institution participating in the program. It also meant that general requirements must be set up to be met by all participating institutions, but that these requirements should be elastic enough to allow the highest possible degree of responsibility on the part of each individual institution.

FLEXIBILITY

"Standard Course Outlines" were to be prepared by the Washington staff from time to time and sent to the institutions. However, these outlines were to be designed only as suggestions and guides to the institutions, and any institution was to feel perfectly free to modify any of them to fit local needs, conforming to the principle that the training afforded should qualify trainees for some particular job in a war industry. The institutions were always to have the greatest freedom to propose new courses in line with this criterion. It was considered highly important to avoid standardisation; to keep the program flexible, able to meet specific local needs as they arose, ready to adjust itself to changing needs and conditions of war industries; and, hence, in a position to serve as effectively as possible in meeting the shortage of engineers, scientists, and production supervisors "in fields essential to the national defense."

These continued to be the fundamental policies of the organisation throughout its life. The Washington staff continually consulted with the two advisory groups and with the participating institutions, and studied policies, procedures, and forms with a view to continuous simplification and expediting of the work in the institutions.

Chapter II

DEVELOPING AND ESTABLISHING THE PROGRAM

THIS CHAPTER contains a brief outline of the considerations which led to the conception of the principal characteristics of the ESMWT program, and of the preliminary investigations and organizational work leading up to the original authorization of the program by the Congress.

NEED FOR EXPANSION OF TRAINING FACILITIES RECOGNIZED

In the spring of 1940 the tragedy at Dunkirk and the collapse of France and the low countries brought home to Americans the realization that courage and self-sacrifice, love of freedom, and patriotism in themselves would be inadequate weapons of defense against modern war machinery, and that America must be prepared with a modern war machine of its own if it wished to be safe against aggression.

The heads of divisions of the U. S. Office of Education called attention to the rapidly expanding national defense activities, which would make necessary a similar expansion of the existing facilities for the education and training of all types of industrial employees.

The Commissioner of Education decided that if Congress approved programs of defense training, the administration of the program of less-than-college grade should be located in the Vocational Division of the Office of Education under the Assistant Commissioner for Vocational Education, and that of college grade in the Division of Higher Education under the Chief of that Division. This decision led to the development of the college-level training program as a separate unit, cooperating with other training programs, but having its own authorization and funds.

As an indication of the importance attached to training as an aspect of national defense, it may be noted that the Council of National Defense gave consideration to the establishment of a separate training agency to include training within industry, vocational training, and training on the college level. The representatives of the Council, however, were advised that training on the college level and vocational training could best be carried on under the U. S. Office of Education, since the Division of Higher Education was acquainted with the problems of the educational institutions of higher learning, and the Office had administered the vocational program of the country for nearly a quarter of a century.

SHORTAGE OF ENGINEERS APPARENT EARLY IN DEFENSE EFFORT

It was realized that a shortage of engineers would be one of the critical bottlenecks in the national defense effort, since the output of engineering colleges was hardly sufficient to meet the needs of American industry for

technological personnel during normal peacetime. It was already evident that the number of engineers who could be graduated from the engineering colleges would fall far short of filling this Nation's need for engineers, assistant engineers, and technicians to aid in the efficient planning, production, operation, management, and research so indispensable to the industrial expansion then contemplated; and that it would be necessary to train large numbers of assistant engineers, draftsmen, inspectors, supervisors, etc., and to prepare many partly or fully trained engineers for specialized work and for more responsible positions.

It was also realized that the part which had been assigned to engineers and scientists in the first world war would be an inadequate measure of the role they must play in modern warfare, if war came to America. In modern warfare a large majority of the men in the armed forces must be specialists of one kind or another, each qualified by training and experience to serve in some one or more of the hundreds of technical jobs necessary to the operation and maintenance of a modern mechanized army and navy. The need for trained men in industry was even more imperative. In the first world war machines were introduced to aid the efforts of the armed forces. In modern warfare it can be said without exaggeration that without machines organized military effort is completely ineffective against a mechanized enemy. Even by 1940 mechanized warfare had become a test of the relative total scientific, engineering, and manufacturing skills and capacities of the belligerent nations. It was evident that a nation, if forced to undergo this test, must have available large numbers of people well prepared in science and its applications.

INDICATED CONTRIBUTION OF ENGINEERING COLLEGES

During the first world war the engineering colleges of this country were responsible for a major portion of the vocational training program of the United States Army, which was almost entirely concerned with the training of mechanics, and gave practically no attention to training on the engineering level. In the 24 years that had intervened, however, the Federal Government had cooperated with the States under the Smith-Hughes and George-Deen Acts in the development of a Nation-wide program of vocational education. More than 1,000 public vocational and trade schools were in existence, with plants valued at over 1 billion dollars. If these could be utilized to give needed instruction at their accustomed level, it was apparent that the engineering colleges might be left free to concentrate on the more advanced training which they were particularly qualified to give.

REPORT OF THE COMMISSIONER OF EDUCATION

This situation was recognized in a report on Training for National Defense made late in May 1940 by the Commissioner at the request of the

President. This report recommended a three-part program comprising the intensified use of existing public trade-school facilities, their further expansion to provide still greater capacity, and the utilization of the engineering colleges to give instruction in a wide variety of fields requiring preparation beyond the trade-school or secondary school level. For the last-mentioned purpose an appropriation of 14 million dollars was recommended for a 10 months' program of instruction in the engineering colleges.

REPORT ENDORSED BY ENGINEERING EDUCATORS

The report of the Commissioner was endorsed by those present at a conference held in Washington early in June which represented the leading national organizations interested in vocational and technical education at both the college and the secondary school level. The statement signed by those in attendance was transmitted with data presented by the Commissioner to the President and to all members of both houses of Congress as evidence that the schools and colleges were ready and willing to launch an enlarged program of training for national defense whenever Federal funds were made available.

The conference estimated that an appropriation of $14,000,000 to the engineering colleges would enable them to train about 20,000 full-time students, or 30,000 part-time students, during a regular 10-month school year.

On June 14, 1940, a group of presidents and deans of engineering colleges met in Washington, at the call of the Commissioner, with representatives of the Army and Navy to discuss the various types of educational services which might be rendered to the national defense training program by the engineering colleges. The conference listed jobs requiring technical training of regular college grade, of subprofessional engineering grade, and at the postgraduate level in professional engineering. It also emphasized the need for "refresher" courses in various fields of engineering, and for intensive short courses to turn out as quickly as possible the many thousands of technically trained persons needed in the program of national defense. It was emphasized that *emergency defense training should be an additional activity which should not interfere with the regular engineering college program.*

FUNDS APPROPRIATED FOR VOCATIONAL TRAINING

On June 22, 1940, Congress appropriated $15,000,000 for a defense training program "of less than college grade," the qualification referring to the character and content of the courses and not to the types of institutions giving the training. No funds were appropriated at this time for a college-level program. While a number of engineering colleges offered to cooperate in this vocational training, the general feeling among engineering educators was that *the engineering colleges could make a more valuable*

contribution to the national defense by utilizing their facilities, without interrupting their regular programs leading to degrees, mainly for specialized training on the engineering college level.

EXPERT CONSULTANT APPOINTED

Early in July, A. A. Potter, Dean of the Schools of Engineering, Purdue University, was appointed expert consultant in the U. S. Office of Education to aid in developing and in presenting a proposal for the consideration of the Defense Council and the Congress as to what the colleges of engineering could do to contribute most effectively to the defense training program; and to be the liaison officer between the engineering schools and the Federal agencies concerned with national defense. Dean Potter had then been engaged in engineering education and consulting engineering practice for more than 35 years. He had served as president or chairman of the American Society of Mechanical Engineers, the American Engineering Council, the Society for the Promotion of Engineering Education, and the committee on engineering schools of the Engineers' Council for Professional Development. He had cooperated previously with the Federal Government, in surveys of engineering education and as an engineering consultant.

Under Dean Potter's guidance the basic principles were established upon which the college-level program was to operate through out its existence. (See ch. I.) When the National Advisory Committee was formed he was chosen as its chairman. He continued to serve in this capacity and also as an expert consultant to the Commissioner and the Director until the end of the program.

Allan W. Horton, Jr., was appointed specialist in engineering education to assist Dean Potter. Mr. Horton, a graduate of the Massachusetts Institute of Technology, had previously served as assistant to President Karl T. Compton of that institution and as secretary to the Committee on Engineering Schools of the Engineers' Council for Professional Development. He was granted leave of absence by the Standard Oil Company of California from his position on their engineering staff to take the new position.

Consultations were held with officials of the National Defense Council, the Army, Navy, Civil Service Commission, Patent Office, Bureau of Labor Statistics, the National Academy of Sciences, the various national engineering societies, the engineering colleges of the country, the United States Maritime Commission, members of Congress, and representatives of industries with respect to:

I. The needs of Government agencies and industry for engineers.
II. The services which might be rendered by the engineering colleges to the national defense program.

III. Desirable policies to be followed by the colleges as to:
   A. Maintenance of staffs and of regular curricula.
   B. Establishment of intensive training programs by those institutions having special facilities for such work.
   C. Conduct of vocational programs in localities not well supplied with vocational schools.

IV. Sources of students and prospects for placement after completion of training.

MUCH NEED FOUND FOR COLLEGE-LEVEL TRAINING

Interviews confirmed the need for engineering training on the college level. While there was still uncertainty as to the extent of the defense program for the next 2 years, these officials were convinced that *its success would depend to an extraordinary degree upon the availability of properly qualified technical and supervisory engineering personnel*, who could not be trained directly either by industry or by the armed forces because of their lack of facilities, and who could not be secured in sufficient numbers through the regular engineering programs of the colleges, even if they be maintained at full efficiency. There had already developed marked shortages in naval architects, draftsmen, marine engineers, aeronautical engineers, machine tool designers, and engineers to supervise and speed up production in the industries essential to a national defense program. Shortages were anticipated in the near future in inspectors familiar with physical, chemical, metallographic, X-ray, and similar tests; for powder and explosives inspectors; radio equipment inspectors; structural and machine designers; tool designers; metallurgists; sanitary experts; industrial personnel supervisors; experts in submarine and airplane detection; designers of special electrical devices; experts in aerial photography and mapping; and similar specialists who require engineering knowledge.

A study was made of the facilities available in the engineering colleges for giving special intensive training courses to meet anticipated shortages of technically trained personnel, and a confidential brief was prepared outlining 31 possible training courses designed to meet anticipated shortages and listing engineering colleges with special facilities in staff and equipment to give this training effectively.

PROPOSED LEGISLATION SUBMITTED TO CONGRESS

As a result of studies a bill was prepared calling for an appropriation of 14 million dollars for engineering defense training on the college level. This figure was based upon an estimated average cost of about $80 per student per month for full-time intensive courses involving about 20 classroom periods and an equal number of hours per week of laboratory or design practice.

Late in July, 1940, the Commissioner issued a supplementary report, "Proposals to Expand the Program of Training for National Defense

Through Schools and Colleges," in which he reiterated his earlier recommendations for the utilization of the facilities of the engineering colleges. He pointed out the shortages which had already developed and which were anticipated, and stated that an appropriation of 14 million dollars would make it possible to provide for the training in engineering colleges of about 58,000 poeple for an average training period of approximately 3 months each. He called attention to the fact that the proposed legislation did not provide funds for use by the colleges in connection with their regular engineering instruction, but that *"funds in this proposal are only to be used in paying salaries of teachers, and for equipment and supplies in connection with the special intensive engineering programs of study directed to meet the urgent emergency needs in the national defense program."* He pointed out that *"the engineering college undertaking this intensive training is expected to make no profit, is to charge no tuition of the trainees, and will be expected also to operate these special courses on prevailing schedules of salaries and other costs."*

NATIONAL ADVISORY COMMITTEE ON ENGINEERING DEFENSE TRAINING APPOINTED

Early in August Dean Potter recommended that a National Advisory Committee on engineering defense training be appointed to aid the Commissioner in formulating policies, in facilitating cooperation of the engineering colleges of the country, and in safeguarding the defense values of the regular educational processes of the engineering colleges. Under date of August 27, 1940, the Commissioner invited 11 engineers and engineering educators to form such a committee. Every man invited to serve on this committee accepted the assignment, as an opportunity to make a contribution to the defense effort. These men served with no compensation to themselves or to their institutions, but with the understanding that expenses incurred in service to the program would be met from EDT funds.

The committee was continued throughout the life of the program, with only a few changes in membership. It rendered most valuable aid to the Commissioner and Director, both of whom consulted with it on all important matters of policy.

The original membership of this committee, with all subsequent changes, is shown in chapter VII, which also contains a further discussion of the contributions of the Committee to the program.

RESPONSIBILITIES OF THE COMMITTEE OUTLINED

At its first meeting the committee recommended "Engineering Defense Training" as the name under which the college-level program should operate if authorized by Congress. This recommendation was approved by the Commissioner. At this meeting it was agreed that the National Advisory

Committee should advise the Commissioner as to (1) policies with respect to relationships between the U. S. Office of Education and the engineering colleges on matters concerned with national defense; (2) the administration of the Engineering Defense Training program, and (3) safeguarding the defense values of the regular educational processes of the engineering colleges.

SUBCOMMITTEE APPOINTED TO SURVEY TRAINING NEEDS

The National Advisory Committee appointed a subcommittee to supervise sample surveys of the needs of defense industries in five representative areas, as a basis for planning the development of a college-level training program in the event that the Congress should authorize such a program.

Surveys were conducted in Pennsylvania and in the areas centering in New York City, Chicago, Los Angeles, and San Francisco. They indicated serious shortages of engineers in a number of industries. For instance, it was found that the aircraft industry of the Long Island and northeastern New Jersey area alone would need nearly half of the output of the engineering colleges of the entire country. In Pittsburgh, Pa., and the 11 surrounding counties only 257 qualified men were found available to meet an expected need for about 10 times that number. Definite shortages of technologically trained people were also found to exist in California and in the Chicago area.

GENERAL POLICIES FOR PROGRAM ADOPTED

At this meeting agreement was reached regarding the following general policies:

(a) Training should be confined to institutions offering regular engineering curricula of 4 years or more leading to degrees.

(b) Selection of institutions should be based upon the special facilities already available at the institution, the need for training, the geographical location of the institution with reference to the demand for trainees and availability of students, cost of providing the training desired, and attitude of the administration of the institution.

(c) Engineering colleges should be encouraged to develop their programs of study to meet the needs of the industries of their localities, and training for Government employment should be planned as a result of conferences with representatives of the Government agencies concerned.

(d) Full responsibility for the selection and admission of students to the defense training program should be vested in the engineering colleges, but high-school graduation should be considered the minimum prerequisite.

(e) The Federal Government should reimburse colleges for all costs of special defense training courses, and no tuition should be charged trainees.

(f) The U. S. Office of Education should not be concerned with credit for the intensive courses given under the program, this being a matter for decision by each institution. (See ch. III, page 38.)

(g) The Engineering Defense Training Program should be coordinated with the less-than-college grade vocational defense training and with the "Training-Within-Industry" program.

PRELIMINARY ORGANIZATION PLANS ADOPTED

Preliminary plans for the organization of the Engineering Defense Training Program were outlined at this meeting. It was recommended that there be a central staff with offices in Washington, and a field staff. The central staff should be responsible for preparing course outlines as suggestions to institutions, approving institutions and programs of study after the establishment of general criteria, and maintaining contacts with agencies of Government with respect to training needs, placement, statistics, and reports.

The field staff should be responsible, in cooperation with the colleges and universities, for surveying the training needs of industry, advising institutions on educational matters, and supervising training programs in the field.

PRELIMINARY ORGANIZATION ESTABLISHED

George W. Case, dean of the College of Technology, University of New Hampshire, on October 7, 1940, joined the staff on a loan basis from his institution, to take charge of the academic phases of the program. (He was later formally appointed principal specialist in engineering education, effective November 4, 1940.) It was originally planned that Dean Potter should be in general administrative charge of the program under the general supervision of Dr. Kelly; that Dean Case should be responsible for all the academic phases of the program; and Mr. Horton (later designated assistant director) for the administrative operations of the Washington office.

It was decided to divide the country into 22 regions and to appoint in each region a regional adviser who would be the chairman of a committee composed of the institutional representatives of institutions situated in his region, and through this committee would coordinate the program in the field. The regional advisers would be asked to contribute their services on a part-time basis with the understanding that their expenses should be covered by the Engineering Defense Training appropriation.

EDT AUTHORIZED BY CONGRESS

Public Law 812 of the Seventy-sixth Congress, 3rd Session, was approved by the President on October 9, 1940. This act appropriated $9,000,000 to cover the cost for the remainder of the fiscal year ending June 30, 1941, of "short engineering courses of college grade, provided by engineering schools or by universities of which the engineering school is a part, pursuant to plans submitted by them and approved by the Commissioner,

which plans shall be for courses designed to meet the shortage of engineers with specialized training in fields essential to the national defense—*Provided*, That only engineering schools which operate under charters which exempt their educational property from taxation shall be eligible to receive these funds: *Provided further;* That not to exceed 20 per centum of the amount allotted to any school shall be allotted to it for expenditure for purchase or rental of additional equipment and leasing of additional space found by the Commissioner necessary for carrying out its approved plan."

The act contained the stipulation that "No trainee . . . shall be discriminated against because of sex, race, or color; and where separate schools are required by law for separate population groups, to the extent needed for trainees of each such group, equitable provision shall be made for facilities and training of like quality."

The provisions of this act were continued in the later acts which extended the life of the program to June 30, 1945, with few modifications. The principal changes were: (1) the addition of courses for chemists, physicists, and production supervisors to the objectives of the program; (2) the provision that courses must be of types approved by the Chairman of the War Manpower Commission; (3) the reduction of the percentage of funds which might be allotted for equipment and space from 20 per centum to 12½ per centum; and (4) the provision that approved equipment purchased with ESMWT funds should become the property of the institutions. (A digest of the various acts under which the program operated, and of the Regulations pursuant thereto, is contained in pt. II, ch. VI.)

Chapter III

GENERAL POLICIES AND PROCEDURES

THE FUNDAMENTAL principles mentioned in chapter I, and the general policies developed during the period preceding the passage of the act formed the basis for the establishment of specific policies and procedures to implement the various Acts authorizing the program. All procedures to be followed by the Washington staff and the participating institutions were designed in the light of these principles and policies. The principal policies and procedures adopted during the life of the program are outlined in this chapter.

REGIONAL ADVISERS APPOINTED AND THEIR DUTIES OUTLINED

The Commissioner took prompt action following the passage of the Act establishing the Engineering Defense Training Program in the appointment of 22 regional advisers to coordinate the program in the colleges with the needs of industry and the Armed Forces. Those invited to serve as regional advisers were recognised leaders in engineering education, who accepted this assignment with no compensation to themselves or to their institutions other than an opportunity to aid in national defense, but with the understanding that their expenses incurred in serving the program would be met from EDT funds.

In his announcement of the appointment of the regional advisers, the Commissioner outlined their responsibilities as follows:

> Each adviser will act, within his own territory, as a liaison officer, maintaining continual contact with defense industries, Army and Navy district officers, employment services, and other sources of information on personnel needs, as well as with local engineering schools equipped to meet the demands for training courses as they arise. These men will keep the Washington headquarters continually informed so that deficiencies in any one region may be met, if necessary, by training students in other places where facilities are available. In this way a national program will be evolved that will continually adjust itself to changing conditions both in industry and as regards the technical personnel of the Federal Government.

At the first meeting of the regional advisers, which was held in Washington on October 31 and November 1, 1940, it was the consensus that each regional adviser could aid the program most effectively by keeping in close touch with the defense industries and engineering colleges of his region, acting as *chairman of a regional committee* of engineering college representatives, each of whom was responsible for the Engineering Defense Training program of his own institution, and keeping the members of this regional committee fully informed of actions taken and reports made at the meetings of regional advisers with the director of the program. It was brought out that while the Commissioner must maintain official contact

directly with each educational institution, and that proposals for courses should be submitted by the institution directly to the Office of Education, the regional adviser could provide an informal and more personal relationship with the institutions which would greatly facilitate progress of the program. The regional committees should work out systematic plans for contacting local industries and federal agencies interested in engineering training, to assure their fullest cooperation in determining training needs as well as in recruiting and placement of trainees. It was decided that periodic reports from regional advisers would not be required, but that they would be expected to keep the Washington office generally advised of the progress of the program in their respective regions, of difficulties encountered, and particularly of training needs which could not be met by local institutions. In return, the Washington office was to keep the regional advisers fully informed of all actions affecting their respective areas.

The regional advisers continued to serve, with a few changes in personnel, throughout the life of the program. Their services, which were invaluable, are discussed more fully in chapter VII, which also contains a list of the original regional advisers, with subsequent changes in the group.

WASHINGTON STAFF EXPANDED

As the program got under way it became evident that the Washington staff required an enlargement in order promptly and effectively to handle details of administration and to insure proper safeguard of the expenditure of Federal funds. It was decided that a full-time director was needed, to be assisted by specialists to handle details pertaining to proposals, auditing, correspondence, information, records, and relationships with the institutions and with the regional advisers.

On November 25, 1940, Roy A. Seaton, dean of the School of Engineering and Architecture, Kansas State College of Agriculture and Applied Science, who was serving EDT as a regional adviser, was appointed director of the program. Dean Seaton held membership in the American Society of Mechanical Engineers and represented the Society for the Promotion of Engineering Education on the Engineers' Council for Professional Development. He had served as director of the National Council of State Boards of Engineering Examiners, president of the Society for the Promotion of Engineering Education, and of the Kansas Engineering Society, and secretary and chairman of the Engineering Section of the Association of Land-Grant Colleges and Universities. For 10 years he had been chairman of the Kansas Registration Board for Professional Engineers.

Under Dean Seaton's leadership during EDT and ESMDT the organization of the Washington office was developed, and working relations were established with other Federal agencies and with the participating institutions.

Other members of the central staff were appointed from time to time as the program expanded and as suitable persons could be secured. The program developed so rapidly and so extensively that throughout its life difficulty was experienced in maintaining a central staff in Washington large enough to handle the necessary administrative details properly. Fortunately, however, the majority of the professional members of the staff remained in service from their appointment until the end of the program, as did the majority of the regional advisers and members of the National Advisory Committee. This continuity of the staff and of the two advisory groups contributed greatly to the stability of policies throughout the life of the program.

Throughout the program the basic principle was followed of direct responsibility of the participating institutions to the Office of Education, with regional coordination effected by the regional advisers and with continuous help and suggestions to the Director in the formulation of general policies from both the National Advisory Committee and the regional advisers.

From the beginning of the program the Washington staff had a dual responsibility to the Federal Government to see that expenditures and activities of the program were kept within the scope and limitations set out in the acts of Congress, and to interpret the limitations so as to promote the purpose of the act. It had a responsibility to the colleges to exercise a minimum of control and to adopt procedures designed to provide the speed and flexibility required in dealing with urgent needs and changing conditions of war industries. There was also a joint responsibility of the colleges and the Washington staff to see that the final records of the program, both in the colleges and in the Washington office, were complete and in such order as to facilitate auditing by the General Accounting Office, which was charged by the Congress with the responsibility of a final settlement and audit of the program.

To administer these responsibilities, principal members of the Washington staff were in the main drawn from important posts in engineering colleges and other professional educational institutions and from industry. The central staff of ESMWT was therefore broadly representative of and thoroughly acquainted with the institutions participating in the program and the industries served. This helped greatly to bring about happy conditions of cooperation among the participating institutions and between them and the industries in their neighborhoods. The principal staff members are listed in part II, chapter VII, which also contains an organization chart and an outline of the organization and operations of the staff.

INFORMATION TO COLLEGES AND THE PUBLIC

It was realized from the beginning that the success of the program in meeting the shortages of technically trained persons would depend in large

measure upon the number of eligible colleges whose cooperation in the program could be secured, and upon the extent to which the training opportunities presented by these colleges could be made known to the industries to be served and to properly qualified trainees. Therefore it was a definite policy from the outset to issue general informational material from the Washington office and from the participating institutions. These took the form of news releases, information bulletins, articles and addresses by staff members, and local announcements of course operations by institutions.

Especially noteworthy in this connection were the series of articles published in the *Journal of Engineering Education*, the official publication of the Society for the Promotion of Engineering Education. These articles, which appeared in every issue of the journal from December 1940 until December 1941, and at intervals thereafter, were of great value in stimulating interest in the program on the part of engineering colleges and their staffs. Also noteworthy were the addresses delivered by Deans Seaton, Potter, and Case before the annual meeting of the Society in June 1941, and published in the September issue of the journal. (See bibliography.)

At this meeting the Society adopted the following resolution:

> The Society for the Promotion of Engineering Education expresses its thanks to Dean R. A. Seaton, Dean A. A. Potter, and Dean G. W. Case for their clear exposition of the need for special Engineering Defense Training and of the procedure now in effect.
>
> The Society feels reassured that the engineering colleges will receive full support for their Engineering Defense Training work as it is expanded to meet the needs arising in the present emergency, and full support also in maintaining their regular engineering educational processes which are proving of notable service in defense measures and which will prove of equally notable service in future reconstruction processes.
>
> The Society endorses the work of Deans Seaton, Potter, and Case and their associates under the supervision of the United States Commissioner of Education.

"ANSWERS TO QUESTIONS" PUBLISHED

Those responsible for the early planning of the program felt that there should be available to the cooperating institutions, as well as to others interested in the program, a manual which would be properly indexed and which would answer accurately questions which might be raised with reference to the objectives, organization, administration, legal aspects, financial requirements, and other features of the program.

The first issue of "Answers to Questions" was released on October 18, 1940, setting forth the general principles upon which the program was to operate, the types of courses to be offered, the responsibilities of the institutions and of the Washington staff, the general criteria to govern the selection of trainees, and the general requirements for [illegible]

program within the institutions. Supplements to this document were issued during the fiscal year as the program developed.

At the beginning of each subsequent fiscal year a revised edition of "Answers to Questions" was published, in which were incorporated the important policies and operating principles developed up to that time. This document served as an operating manual for the participating institutions and the Washington staff, and to other interested persons as a source of general information concerning the program.

GENERAL RESPONSIBILITIES OF WASHINGTON STAFF AND OF PARTICIPATING INSTITUTIONS

The general functions of the Washington staff, in addition to the establishment of policies and procedures for the operation of the program, included (1) the approval of institutions for participation in the program; (2) the approval of course proposals and the keeping of records thereof; (3) accounting and auditing; (4) research and statistics; (5) publishing information and reports; and (6) cooperation with other Federal agencies.

Each participating institution assumed certain responsibilities under the "Plan" submitted by it for each fiscal year of participation. The most important of these responsibilities were for (1) the determination of local training needs; (2) the design of courses to meet these needs; (3) the recruiting, selecting, and placing of trainees; (4) the selection, training, and supervision of teachers; (5) the submission of proposals and reports to the Washington office; (6) the expenditure of Federal funds only for approved costs of courses and the accounting of such expenditures in a manner to facilitate a thorough audit; and (7) the maintenance of institutional records.

The principal policies and procedures developed to discharge these responsibilities are outlined briefly in this chapter, leaving the details of organization and administration to be discussed in part II, chapter VII.

APPROVAL OF INSTITUTIONS FOR PARTICIPATION

An institution desiring to participate in the program submitted to the director a formal "Plan" containing evidence of the institution's eligibility to participate in the program under the terms of the Act and setting forth the principal responsibilities which it would assume if approved for participation, as outlined above.

The plan designated a member of the institutional staff as institutional representative and outlined his duties and responsibilities, which included maintenance of the standards and policies of the institution and of the U. S. Office of Education, clearing and coordinating all matters pertaining to activities of the institution under its plan, conducting negotiations with and submitting required reports to the director, and providing representation of the institution on regional committees.

The plan had the force of a contract signed by an official of the institution with authority of the board of trustees to sign contracts, usually the president of the institution. The institutional representative acted as the authorized representative of the president of the institution, and it was recognized in the Washington office that in the handling of the institution's program he was working under policies established and approved by the president of his institution.

The plan was examined by the members of the Washington staff to determine the eligibility of the institution to conduct courses in one or more of the fields included in the program. The approval of the plan by the director established the institution as a participating institution eligible to offer courses in the field or fields designated in the plan.

USE OF FACILITIES OF NONELIGIBLE INSTITUTIONS

The various Acts under which the program operated specified that only degree-granting institutions were eligible for direct participation in the program. However, in order to provide greater flexibility in meeting the needs of industry through the conduct of courses in locations readily accessible to trainees, provision was made for the renting of equipment and the leasing of space.

It was found desirable to utilize the equipment and space of many educational institutions which, while unable to qualify under the law for direct participation in the program, possessed facilities usable in the conduct of ESMWT courses, and in many cases staff members qualified to teach them.

The policy was adopted that participating institutions might utilize the facilities of noneligible institutions, when found to be more suitable or economical than other available facilities, on a rental basis, with the provision that the participating institutions have complete responsibility for the conduct of all courses and for the maintenance of proper standards therein.

An early and unique development under this policy was the creation of the Defense Training Institute in Brooklyn, N. Y. This organization, sponsored by all the participating institutions in New York City and administered by the Polytechnic Institute of Brooklyn, was formed to conduct courses to meet the needs for subprofessional training which had been brought out in the New York City area survey, leaving the participating institutions free to use their regular staffs and facilities to conduct their regular programs and more advanced engineering courses in the EDT program.

The Defense Training Institute continued to operate successfully during the first 4 years of the program, during which time it enrolled a total of 2,115 full time trainees.

APPROVAL OF COURSE PROPOSALS

Local training needs were discovered by the institutions in several ways, such as industrial surveys, personal contacts between staff members and industrial executives, and other methods which will be discussed in chapter V. The acquaintanceship which the engineering college staffs of the country had with industrial executives through professional contacts was an important factor not only in establishing proper relationships between the institutions and the industries, but also in uncovering needs for specialized training.

When an institution discovered a need for defense training which it felt prepared to meet, a course was planned to fill the need, generally in consultation with officials of the companies to be served. A preliminary proposal was then prepared, on blanks furnished by the Washington office. This proposal set forth the nature and extent of the defense needs to be met, an outline of the course proposed to fill the needs, the number and qualifications of trainees it was proposed to enroll, the method by which they would be placed in employment after completing the course, the names and qualifications of proposed instructors, and the estimated cost of the course for maximum, desired, and minimum numbers of trainees. Cost figures were broken down to show the cost of organization, administration, instruction, additional equipment and space, and other items.

This preliminary proposal was analyzed by members of the Washington staff as to its conformity with basic requirements, whether the course as outlined came within the intent of the law, whether a real need for the proposed training was shown, whether the course was well planned to accomplish the desired purpose, whether the staff and equipment were adequate, whether the unit cost was reasonable, and other considerations. If the information given in the proposal was ambiguous or inadequate, correspondence with the institution was necessary to secure supplementary information. If the proposal was approved, a formal authorization to organize the course was executed, attached to the duplicate copy of the proposal, and returned to the institution. The original copy was retained in the Washington office and funds were encumbered to pay the estimated cost of the course.

Upon receipt of the approved preliminary proposal the institution proceeded to organize the course, enroll trainees, and begin instruction. If the minimum number of trainees approved for the course could not be obtained, the course was cancelled, otherwise after the class had met for 1 week a final proposal was prepared by the institution on the basis of actual enrollments and a much more definite estimate of probable costs. This proposal was forwarded to the Washington office where it received the same careful analysis which had been given the preliminary proposal. When the final proposal was approved, the encumbrance which had been

set up to cover the cost as estimated in the preliminary proposal was cancelled and was replaced by the revised figure as approved on the final proposal. This amount was certified to the United States Treasury for payment to the institution.

After completion of instruction for a fiscal year, the institution prepared a Final Report in which it accounted for all expenditures, and with which it returned to the Washington office any unexpended balance from the amount sent it during the year by the United States Treasury. This refund was immediately transmitted by the Office of Education to the Treasury.

Provision was made in the procedure to pay necessary organizational expenses incurred by the institution in attempting to organize approved courses which for one reason or another were not conducted. Such costs were either included in the administrative charges of the institution, or in a final proposal covering the organizational expenses.

This procedure insured that only actual costs of items approved in advance by the Director would be paid from Federal funds; that there would be available, within the amount appropriated by Congress, funds to pay all such costs; and that the institutions would be enabled to operate the program with a minimum use of their own funds; but it created certain administrative difficulties.

The Washington office, owing to the small administrative appropriation, was unable to employ adequate staff to process final proposals immediately upon their receipt. This resulted in a considerable time lag between the encumbrance of funds for courses when preliminary proposals were approved and the actual transmittal of funds to the institutions to cover the costs of the same courses. On any particular date there might be encumbrances on the records of the Washington office in excess of the amount which would later be certified to the Treasury for payment to the institutions. It was considered necessary to keep all encumbrances on the records until final proposals were received or preliminary proposals cancelled, in order to assure that sufficient funds would be available to pay the cost of all approved courses if they were conducted.

In order to protect appropriated funds from any overdraft, the preliminary proposal was made large enough to cover the complete cost of operating the course as estimated in the preliminary proposal for the maximum number of trainees proposed. The participating institutions submitted preliminary proposals in advance of the desired starting dates so that they could receive approval of a course before obligating themselves to any large expenses. It was usually quite difficult for them to anticipate accurately the number of trainees who would enroll in a given course, and frequently their estimate proved to be larger than the number actually enrolled.

Because of the economies resulting from smaller enrollments than those anticipated, from the necessary cancellation of some courses, from the inability of institutions to purchase approved equipment, and because of definite efforts by the colleges to keep costs down to a practical minimum, the participating institutions generally spent less than the amounts approved on final proposals, and, hence, at the close of each fiscal year institutions returned money to the Federal Treasury.

These conditions made it impossible for the entire amount appropriated by Congress to be used to pay the cost of courses, and resulted in a portion of appropriated funds remaining unused at the end of each year.

After the close of the ESMDT program, it was decided that past experience would justify the encumbrance of the amount estimated in the preliminary proposals for the "desired" enrollment, rather than the "maximum" enrollment, as had been the practice for the preceding 2 years. This decision reduced the gap between encumbrances and allotments, but an appreciable gap still existed and a portion of appropriated funds remained unused at the end of each fiscal year.

The total amount appropriated by Congress for the cost of courses during the life of the program was $88,500,000, plus a reappropriation for 1944–45 of $6,000,000 appropriated for 1943–44 but not expended in that year. Of this amount $59,967,065 was expended to cover the cost of courses, and $28,532,935 was returned to the United States Treasury. The high percentage of appropriated funds which was not used was due largely to small administrative appropriations for developing the program and to the great care which was exercised by the Washington staff and by the institutions throughout the program to insure strict economy in its operation.

COURSES TO TRAIN ESMWT TEACHERS

In 1941 when it became evident that the defense effort would require large numbers of people trained in the special techniques of the chemistry of explosives, it was found that there were only a few teachers of chemistry in the country who had specialized sufficiently in this particular field to give the required instruction. Arrangements were made with Washington University in St. Louis, Mo., to offer an EDT course for the training of teachers, to prepare them in turn to give courses in their respective institutions to properly qualified trainees. It was decided that expenses incurred by a faculty member in attending this course would be a legitimate charge against the organization cost of the EDT course in Chemistry of Explosives to be given later by his institution.

The offering of this course for the training of teachers established a new principle in the EDT program, which later was followed in connection with courses in ultra-high-frequency techniques, in aerial bombardment

protection, in quality control by statistical methods, and to a limited extent in the training of teachers of mathematics, physics, and chemistry.

SUMMER PROGRAMS—USE OF FUNDS AFTER JUNE 30

To insure maximum flexibility of the programs of the participating institutions, it was essential that courses be started when needed, and carried through to completion. If all courses must stop on June 30 (the end of the fiscal year), few could be started during May or June, and there would result a gap of about 2 months in the service being rendered to industry by the program. Authority was therefor sought to carry courses starting during these months to completion even though they would extend into a new fiscal year.

Under date of January 16, 1941, the Comptroller General of the United States rendered an opinion to the effect that EDT funds could be used subsequent to June 30, 1941, to cover approved costs of courses begun before but not completed until after that date, and that adjustments could be made subsequent to June 30 to cover costs of courses authorized prior to that date. This opinion formed the basis for the continuation of courses in the EDT program through the summer of 1941, and also for similar continuations of later programs through the summers of 1942, 1943, and 1944.

PROGRAM EXPANDED TO INCLUDE TRAINING FOR CHEMISTS, PHYSICISTS, AND PRODUCTION SUPERVISORS

The industrial contacts established by the Washington staff and the Institutional Representatives in connection with the EDT program disclosed the fact that in addition to a serious shortage of engineers in industry, there were also shortages in the supply of adequately trained chemists, physicists, and production supervisors. Some of these needs could be met through the EDT program, but many of them called for training of kinds not authorized under EDT.

There was therefore submitted to the Congress a proposal that for the fiscal year 1941–42 the EDT program be expanded to include the training of chemists, physicists, and production supervisors, and that the amount appropriated be increased over that available for EDT.

On May 19, 1941, the Commissioner held a conference of representatives of Federal agencies, of colleges of business and commerce, and of the EDT Washington staff, to discuss desirable changes in the organization and administration of the program in the event that the proposed budget be approved by the Congress.

The conference recommended that the expanded program be called "Engineering, Science, and Management Defense Training"; that Clare E. Griffin, dean, School of Business Administration, University of Michigan, be named to the National Advisory Committee; that a specialist in

management be added to the Washington staff; and "that courses in the field of management be approved by the Office of Education only if they are proposed by schools (whether engineering or commerce schools) which are best equipped to give these courses."

These recommendations were accepted by the Commissioner.

The Bureau of the Budget approved the proposed expansion of the program and recommended an appropriation for the fiscal year 1941–42 of $17,500,000, of which $16,400,000 should be allocated for the training of engineers, $500,000 for the training of chemists, $100,000 for the training of physicists, and $500,000 for the training of production supervisors. This stipulation of the Bureau of the Budget as to the allocation of funds between the four fields was later found to restrict the program unnecessarily, and during the course of the year, by agreement between the Commissioner and the Bureau of the Budget, certain transfers of funds were made which permitted larger amounts to be expended for training in the three new fields. All later appropriations were made without any specific allocation as between the four fields.

Public Law 166, 77th Congress, 1st Session, which was approved by the President on July 1, 1941, appropriated $17,500,000 "for the cost of short courses of college grade provided by degree-granting colleges and universities—designed to meet the shortage of engineers, chemists, physicists, and production supervisors in fields essential to the national defense, . . ."

"Degree granting" as used above was interpreted to mean that the institutions, in recognition of satisfactory completion of a curriculum of 4 years or longer beyond high-school graduation, during the academic year 1940–41 granted degrees with a major leading to a professional career in engineering, chemistry, physics, or production supervision.

Early in the ESMDT program, a letter was sent to the participating institutions listing certain fields of training frequently provided in schools of business administration "which fall outside the scope of the ESMDT program and in which courses *will not* be approved." The fields named were Finance, Marketing, Insurance, Sociology, Political Science, and Economic Theory.

Fields of training in which courses might be approved to meet defense needs were listed as Accounting, Industrial Organization and Management, Office Management, Personnel Administration, Procurement and Stores, Statistics, and Transportation.

Suggested courses were listed in each of the above fields, as examples of the types of instruction which might be approved.

Instructions sent to the institutions dated July 1, 1942, stated that accounting courses should, in general, be of an advanced nature, such as cost accounting, budgetary accounting, etc., and that basic accounting courses should be proposed only to meet urgent needs for the training of persons

already employed or employable in accounting work of defense industries and that "courses in elementary bookkeeping cannot be approved."

GENERAL LIMITATIONS ON PROGRAM

Certain limitations were placed on the types of courses which might be approved. The first such limitation was announced on February 18, 1942, based on instructions issued by the Director of Defense Training of the Federal Security Agency because of the limited funds available for ESMDT courses. It stated that no ESMDT courses for enlisted personnel of the armed forces would thereafter be approved for payment from ESMDT funds, although courses already approved for enlisted personnel might be continued to completion. This restriction did not apply to the approval of courses for officers or civilian employees of the armed forces.

In September 1942 a list of subjects was issued as being illustrative, but not all-inclusive, of courses which did not come within the ESMWT program and which would therefore be disapproved unless exceptional conditions, fully stated in the proposal, showed that the planned course would clearly provide training for a specific activity to meet a war need within the fields named in the Act. The courses listed were:

Letter Writing
Business Communications
Office Machine Operating
Elementary Accounting
Navigation
Pilot Training
Courses for Enlisted Men in the Armed Forces
Radio or Telegraph Code Practice
Camouflage
Meterology or Weather Forecasting
Medical Laboratory or Clinical Techniques for Hospital Service
Management for Government Departments

In the same month the institutions were notified that Congress had rejected a proposal to extend the program by authorizing the training of Federal management personnel, and that therefore the training of Federal supervisory personnel should be restricted to courses in the supervision of production activities such as are carried on in arsenals, armories, ordnance plants, Navy yards, TVA., etc., as distinguished from the training of Federal administrative and executive personnel.

In the spring of 1945 a letter was sent to the participating institutions concerning "the propriety of employing persons in the training departments of industrial concerns having war contracts, to train employees of their own companies in ESMWT courses and be paid for this service out of ESMWT funds." The institutions were asked to be guided by the following policy in dealing with this situation:

> (1) A training director or member of the training department of an industrial concern may be employed and paid out of ESMWT funds to teach people not employed by his company or for the purpose of planning or organizing programs of training for people outside of his own organization.

(2) A training director or training department staff member may train people in his own organization in ESMWT courses if he does not receive compensation for his own services out of ESMWT funds.

(3) A training director or training department staff member may be paid out of ESMWT funds to organize, supervise, or instruct courses for people outside of his organization when a small percentage of the class (10 percent or 15 percent) is made up of trainees from his own company.

The above conditions also apply to members of personnel departments whose duties, as recognized by their regular employers, include administering, teaching, organizing, or supervising classes composed of company employees.

This memorandum does not in any way refer to the employment of other technical and supervisory personnel in industry to teach, organize, or supervise ESMWT courses."

COOPERATION WITH WAR MANPOWER COMMISSION

The Chairman of the War Manpower Commission, in implementing Executive Orders of the President creating the War Manpower Commission and outlining its powers and duties, in December 1942, issued an Administrative Order in which he named ESMWT as one of the agencies to comprise the Bureau of Training of the War Manpower Commission. This action later failed of approval by the Congress, but in the meantime a plan of operation was adopted in consultation with the director of the Bureau of Training which made the relationship between ESMWT and the War Manpower Commission effective with a minimum of disturbance to existing ESMWT procedures and operations.

The boundaries of a few of the existing ESMWT regions were revised in such a way that the resulting regions could be grouped to fit into the 12 War Manpower Commission regions. All the ESMWT regional advisers and the two associate regional advisers, with their regional organizations, were retained to facilitate the operation of the ESMWT program. In each of the 12 War Manpower Commission regions one ESMWT regional adviser was appointed as ESMWT regional representative to the War Manpower Commission.

The regional representative was designated as the chairman of a committee of the ESMWT regional advisers whose regions composed the WMC region. He was to be a working member of a committee composed of representatives of the six training agencies named as comprising the Bureau of Training, under the chairmanship of the WMC regional chief of training. This committee was to be responsible for the preparation of training programs for the WMC region. The ESMWT regional representative was also to serve in an advisory capacity to the WMC chief of training, keeping him informed as to the progress of the ESMWT program in his region.

All contacts of the WMC regional chief of training with the institutions participating in the ESMWT program and with ESMWT regional ad-

visers were to be made through the ESMWT regional representatives, and ESMWT was to conduct all procedures connected with the authorization of courses and other administrative operations in the same manner as formerly.

The act which appropriated funds for the ESMWT program for the fiscal year 1943–44 specified that courses conducted under ESMWT must be "of types approved by the Chairman of the War Manpower Commission," but repeated the provision of the preceding year that the regulations pursuant to the act should be promulgated by the Commissioner "under the supervision and direction of the Federal Security Administrator and approved by the President."

However, the contacts with the War Manpower Commission had been found of value to both agencies in their mutual efforts to make the most effective use of the funds appropriated by Congress to conduct training needed by war industries, and the relationships outlined above were continued on a voluntary cooperative basis throughout the remaining life of the program.

The relations between ESMWT and the War Manpower Commission are depicted graphically in figure 1 (page 75) in chapter VII, in which chapter these relations are discussed further.

TYPES OF INSTRUCTION OFFERED

Local differences in training needs, in facilities for instruction, and in the availability of qualified trainees resulted in several general types of courses being given in the program. Some courses were designed to prepare trainees for employment in defense work; others to upgrade those already so employed. Some required the full time of the students; others were given after working hours. The time necessary to complete courses varied from a few weeks to several months, although the most common length was between 12 and 16 weeks. Classes were held both on and off the college campuses, utilizing the facilities of extension centers, noneligible colleges, high schools, and industrial plants. In the fall of 1942 correspondence courses were offered for the training of teachers of mathematics and physics.

The purpose of the program, "to meet the shortage of engineers, chemists, physicists, and production supervisors with specialized training in fields essential to the national defense" was accomplished in a number of ways:

(1) By teaching the fundamentals of engineering or of a field of science or management to those without previous technical training or experience—graduates of high schools or of nonengineering college courses—to fit them for service as assistants to engineers, scientists, or production supervisors, and for subprofessional duties in one of these fields.

(2) By giving employees in defense plants training that would fit them for more difficult and responsible work, or render them more efficient in their current work.
(3) By giving professional persons instruction in defense specialties in which they had hitherto had little or no experience, such as classes in aircraft structural design for civil engineers.
(4) By giving refresher courses to engineers and other professional persons who needed to be brought up to date on recent developments in their fields.

In the earlier planning stage, it was assumed that although inservice training would necessarily be part-time instruction, most of the pre-employment training would take the form of full-time courses. Experience soon showed that it was very difficult to procure suitable numbers of qualified trainees who were able and willing to enroll in full-time courses. Table I in chapter IV shows that for the entire 5 years of the program only 6 percent of the trainees were enrolled in full-time courses.

Courses varied from basic courses like engineering drawing and elementary chemistry to highly refined specialties such as aircraft engine design, X-Ray inspection, and ultra-high-frequency techniques. Prerequisites for admission to these courses varied from high-school graduation or its equivalent in experience to the possession of a college degree, and in a few instances to the possession of an advanced degree.

The Act which appropriated funds for ESMWT for the fiscal year 1943–44 specified that the courses offered must be "of types approved by the chairman of the War Manpower Commission . . ." Under date of July 20, 1943, he approved the following types of courses to be conducted by ESMWT:

A. Types of Courses Designed to Meet the Shortages of Engineers

1. Basic sciences for engineers.
2. General engineering fundamentals
3. Aeronautical engineering
4. Architectural engineering
5. Ceramic engineering
6. Chemical engineering
7. Civil engineering
8. Electrical engineering
9. Industrial engineering
10. Marine engineering and naval architecture
11. Mechanical engineering
12. Metallurgical engineering
13. Mining engineering
14. Engineering applied to the production of textiles, foods, and other war materials

B. Types of Courses Designed to Meet the Shortages of Chemists

1. General chemistry
2. Analytical chemistry
3. Inorganic chemistry

4. Organic chemistry
5. Physical chemistry
6. Biological chemistry
7. Application of chemistry to special war problems

C. *Types of Courses Designed to Meet the Shortages of Physicists*

1. General physics
2. Mechanics
3. Heat
4. Light, including spectroscopy
5. Sound
6. Electricity and magnetism, including X-rays and electronics
7. Physical instruments and measurements
8. Special applications of physics to war problems

D. *Types of Courses Designed to Meet the Shortages of Production Supervisors*

1. Principles of production management
2. Accounting and control
3. Office management
4. Personnel administration and labor relations
5. Statistics
6. Procurement and stores
7. Traffic management
8. Special management problems in war production

This basic list was used throughout the remainder of the program. The enrollment under the various divisions of this list are shown in table II in chapter IV.

FINANCIAL POLICIES AND CONTROLS

A basic principle of the program was that participating institutions should be reimbursed for all proper costs incurred in conducting approved courses which would not have been incurred had the courses not been given. In order to protect the institutions and at the same time discharge the obligation of the Office of Education to meet the intent of Congress, certain financial policies and controls were developed during the program. The principal ones are outlined in succeeding paragraphs.

PAYMENT FOR EQUIPMENT AND SUPPLIES DELAYED IN DELIVERY

In October 1941, the institutions were advised concerning the procedure to be followed when equipment and supplies ordered against EDT funds had been delayed in delivery until after the completion of the EDT course for which they were approved. The letter stated:

> If such equipment or supplies will not be needed in ESMDT courses to be given this fiscal year and have not yet been received, the orders should be cancelled, if possible.
>
> If the equipment and supplies will be needed in ESMDT courses to be given this fiscal year, or have already been received, or cannot be cancelled, the orders should be allowed to stand and the cost paid from EDT funds when delivery is made.

REIMBURSEMENT FOR COSTS NOT DIRECTLY ASCERTAINABLE

The budgets included in course proposals, which have already been discussed (page 22) covered the costs which could be directly ascertained as being chargeable to the courses. However, some institutional services which were essential to the proper conduct of the program were very difficult to itemize, such as the general services of the library, accounting and purchasing departments, and the administrative officers. To provide reimbursement for such costs the institutions were authorized under the Regulations issued in 1942, subject to prior approval by the Director, to charge to the cost of courses a percentage of definitely ascertainable costs, which was to be justified by such evidence as the Director might require.

This authorization was extended to cover compensation for depreciation (but not obsolescence) of laboratory equipment belonging to the institutions, by reason of its use in ESMWT courses, the charge for depreciation being expressed as a percentage of the cost of personal services for laboratory instruction.

WORKING FUND

In 1942 the procedure was established of sending to participating institutions on request a working fund to enable the institutions to meet the needs of their programs during the period between the starting of courses and the receipt of funds from the United States Treasury without drawing on institutional funds. It was specified that the amount requested should not exceed the anticipated average expenses of the institution's ESMWT program for a period of 2 months, and that expenditures from the working fund could be made only for items approved on final proposals or proposals for regional coordination.

Near the end of the fiscal year detailed instructions were sent to the institutions as to the method of transferring working funds permanently to pay for the cost of courses.

This procedure was continued through the remaining years of the program, although the amount to be sent to an institution was reduced during the last year of the program.

ADMINISTRATIVE BUDGET

The early experience showed that from the cost estimates for a large number of separate courses it was difficult for the Washington staff to form an accurate conception of the administrative organization in an institution. Therefore, in 1942 participating institutions were requested to make preliminary estimates of administrative costs for the institution's program for a period to be set by the institution, but not to exceed 5 months. Each institution was asked to submit a proposal setting forth its estimated administrative costs and delineating the organization proposed by the institution to conduct its ESMWT program.

After the total administrative budget was prepared, the pro-rata cost per section was calculated based on the number of sections the institution proposed to conduct during the period covered by the proposal. The results, when approved, were used in the estimates of costs in preliminary and final proposals. Provision was made for revision of the pro-rata cost if changed conditions made revisions necessary.

This procedure was continued through the remainder of the program.

CRITERIA FOR SALARY SCALES OF SUPERVISORS AND TEACHERS

In the "Manual of Forms and Procedures" issued at the beginning of the ESMWT-I program, formulas were suggested for use in determining approximate salary rates for supervisors and teachers of ESMWT courses, in terms of regular institutional salaries. It was suggested that the time required for supervision could best be measured in actual or clock-hours spent on the course, and that the rate per clock-hour should approximate 1/1200 of the regular salary paid by the institution to a teacher of the given rank on a 10 months' basis.

For teachers the unit of measure suggested was the contact-hour, defined as an hour of actual contact with the class in lecture, recitation, or laboratory, which assumed that considerable time not separately charged for would also be spent outside the class in preparation, grading of papers, conferences, and the like. It was suggested that the rate per contact-hour should approximate 1/600 of the regular salary paid by the institution to teachers of like rank on a 10 months' basis.

For both supervisors and teachers the statement was made that the rate should conform to the rate customarily paid by the institution for similar work, and that it might be advisable in determining ESMWT rates to take into consideration any already established local rates.

Later in the year the Washington staff adopted a definition of "educational supervision" in order that everyone connected with the program might have a common understanding of the distinction between costs properly belonging under Instruction (including educational supervision) and those belonging under Administration (including general supervision).

The ESMWT staff considered that "educational supervision" should be limited to supervision related directly to subject matter and requiring technical knowledge of the field covered by the course, including such items as:

1. Preparation or approval of course outline in cooperation with specialists in industry or armed forces.
2. Establishment of prerequisites for admission to the course.
3. Approval of technical qualifications of instructor.
4. Preparation or approval of examinations, if aid is required.

The staff considered further that aspects of supervision less directly concerned with subject matter should be charged to General Administration, including such items as arranging for classrooms; supervision of general teaching methods; and checking equipment, reports, and records.

It was suggested that for the sake of simplicity the cost for a supervisor's time need not be divided between general administration and educational supervision, but might be charged to the classification to which the major portion of his time was devoted.

USE OF "SAVINGS"

In order to make certain that the reduced appropriation for the fiscal year 1944–45 be used in the most effective manner, the institutions were asked to maintain such bookkeeping records as would enable them to promptly report "Savings" at intervals through the year, in order that such savings might be utilized to pay the cost of later ESMWT courses. During the fiscal year the institutions reported total savings of $416,000 out of total allotments of $6,800,000, or about 6 percent.

CLOSER ACCOUNTING OF ENCUMBERED FUNDS

As further efforts to insure the greatest effectiveness in the use of funds during the fiscal year 1944–45, a reduction was made in the size of the working fund available to an institution, and certain new policies as to course approvals were instituted to reduce the "spread" between the amounts encumbered on preliminary proposals and those approved on final proposals. The new policies were stated as follows:

(a) To authorize courses not more than 1 month in advance of the proposed starting date.
(b) To limit each proposal to sections in which the starting dates of instruction fall within a period of 2 weeks.
(c) To cancel a course authorization if the opening enrollment report is not mailed within 2 weeks after the approved starting date, unless a change in this date has been approved.

In addition to these changes, the institutions were urged to cooperate by keeping their own records up to date at all times, and by the prompt submission of requests for course cancellations or for changes in starting dates, of final proposals, and of opening and closing enrollment reports.

Following a hearing before the Bureau of the Budget on October 6, 1944, at which it was stated that the program should be considerably restricted with a view to closing it out completely following V-E Day, plans were made for the requested curtailment. On November 15, 1944, a letter was sent to participating institutions to explain the situation and request them to limit their courses to those having "immediate application in meeting

clear-cut urgent needs of war industry." The proposal was that training be discontinued for much of the more elementary training and in all cases where training needs appeared to exist but could not be clearly defined as immediately necessary to the progress of the war. The effects of this communication (ESMWT-Misc. 3030) will be discussed in chapter VIII, page 138.

TITLE TO EQUIPMENT AND SUPPLIES

The various Acts under which ESMWT operated were specific in their limitation of the amount of funds which could be expended for the purchase or rental of equipment and the leasing of space, but left some doubt as to the ultimate disposition of equipment purchased with ESMWT funds. The Regulations stipulated that equipment was to be held for use in training courses, subject to transfer by the Director, and that "for these purposes title . . . shall be in the college . . ." Participating institutions were advised on several occasions to hold all such equipment subject to audit at any time, and subject to transfer by the director. They were also advised that they should maintain complete and detailed inventory records of equipment purchased under the EDT, ESMDT, and ESMWT programs, and that it should be appropriately marked or tagged for identification.

The approval by Congress of Public Law 124, Seventy-ninth Congress, First Session, finally settled the question of the disposition of equipment and supplies by vesting clear title in the institutions authorized to purchase them, with the provision that "no school or school system shall be required to surrender possession or use of any property or equipment which it is using in its educational or training programs." This provision was made to protect those institutions which, while ineligible for active participation in the program, had contributed to the program by the conduct of courses under the supervision of eligible institutions.

COSTS

ESMWT was in essence not a national program, but a large number of local programs conducted under a uniform code of general policies but under widely differing local conditions of operation and administration. The diversity in type and size of participating institutions and of industries served led to a great variety in courses and operating conditions, resulting in costs of instruction which varied over such a wide range as to make any general averages of rather doubtful significance.

The cost of any course was dependent on such factors as the salary scale of the teachers employed, the length of the course, the number of trainees enrolled, the amount of time devoted to laboratory instruction, the amount and kind of equipment necessary for conducting the course, the

amount of rent necessary for off-campus space in which to conduct the course, the administrative expenses connected with organising and conducting the course, the cost of regional coordination, and other factors, all of which varied over a wide range as between institutions and even between different courses in the same institution.

Costs per trainee-hour were calculated during the first 3 years of the program, by institutions and by subject matter of courses. In the EDT program the average cost per trainee-hour was 44 cents, with a range among institutions of from 11 cents to $1.15, and among types of courses of from 16 cents to $1.49. During ESMDT the average cost per trainee-hour was 46 cents, with a range from 13 cents to $1.07 in different institutions, and from 33 cents to $1.42 for different types of courses. In ESMWT-I the average was 39 cents, the inter-institutional range from 15 cents to 93 cents, and the inter-course range from 18 cents to $1.23.

A total of 1,795,716 persons were trained during the entire program, at a cost of $59,967,065. This indicates an average cost per trainee of $33.40. However, even this figure should be used with caution, since courses varied in length from about 20 contact-hours to 600 or more. The average for all courses conducted was approximately 100 contact-hours. Dividing this into the cost per trainee shown above gives an average cost of 33 cents per trainee-hour, a figure which compares very favorably with unit costs of other training programs.

The total amount expended for the purchase of equipment by participating institutions was $3,386,793, or 5.7 percent of the total cost of the program.

The total cost of the program, $59,967,065, was made up of the following principal items: (1) General Institutional Administration, $14,532,622, or 24.2 percent; (2) Instruction, $40,445,822, or 67.5 percent; (3) Maintenance and Operation of Plant, $4,988,621, or 8.3 percent.

Here again a great range exists in the figures for different institutions, because of wide variations in local conditions. The urgent need for setting up training classes in the shortest possible time, the scarcity of well-qualified personnel, the great variety of courses, and the fact that most of the training was in-service, necessitated the setting up in some institutions of large administrative and supervisory staffs. In some cases, the cost of supervision approached the actual cost of instruction, because of the difficulties encountered by the institutions in uncovering urgent training needs and in finding suitable teachers, and the need for conferences with men in industry to make certain that the instructional program was effective.

Table V in chapter VII shows the total expenditures of ESMWT funds by each institution during each year of participation in the program, while table VI shows the distribution of total institutional expenditures into the

principal items mentioned above, and also the total expenditure for the purchase of equipment.

APPRAISALS OF THE PROGRAM

It was the policy of the Washington staff throughout the program to make continuous appraisals and checks of the effectiveness of the program and the results being attained. The first formal appraisive study was made in the spring of 1941 by means of a questionnaire sent to the institutions asking for their evaluations of the program, their estimates as to its future size, and suggestions as to ways in which the program might be made more effective.

At about the same time, industrial and governmental executives were asked, both by the Training-Within-Industry Division of the Office of Production Management and by the colleges and universities participating in the EDT program, to give their opinions as to the effectiveness of this program in expediting defense. A formal study of more than a thousand replies was prepared in the fall of 1941 and was published in the *Journal of Engineering Education* of the Society for the Promotion of Engineering Education in February 1942, under the title "Are the EDT–ESMDT Programs Expediting Defense?" This and other specific studies of appraisal made during the life of the program are discussed in chapter VIII.

The Washington staff, the National Advisory Committee members, and the regional advisers maintained continuous contacts with the Army, Navy, Civil Service Commission, War Manpower Commission, and with war industries, in order to make certain that critical needs were not being overlooked.

A considerable amount of time at meetings of the National Advisory Committee and of the regional advisers was devoted to evaluations by the members of the groups of the effectiveness of the program as they were able to judge it from their contacts in the field. Most of these meetings were attended by governmental and industrial executives, who were the source of many valuable suggestions for the improvement and strengthening of the program. Following these meetings, it was customary for the regional advisers to hold conferences with institutional representatives of their respective regions, to discuss with them the points brought out at the Washington meetings. Consideration was given at these conferences to any criticisms which had been directed to the program.

The institutional representatives were frequently asked by the director for comments on the general effectiveness of their institutional programs and for estimates of future training needs in the areas served by their institutions. Such estimates were particularly valuable in the preparation of the budget estimates which were submitted to the Bureau of the Budget and the Congress for the successive years of operation of the program.

The Washington office continued to receive letters of appraisal from governmental and industrial executives throughout the life of the program. These letters, which were a constant source of inspiration to those responsible for the program, constituted in some degree a continuous running check on the effectiveness of the program.

Thus the entire organization, including the Washington staff, the regional advisers, and the institutional representatives, became in effect a continuous self-appraising agency, constantly attempting to make certain that all courses were designed and conducted in such manner as to make real and effective contributions to the war effort, rather than simply to benefit individual trainees.

CREDIT FOR ESMWT COURSES

Since the stipulation was made throughout the program that all ESMWT courses should be conducted at the college level, it was natural that the question of academic credit for these courses should arise. At the first meeting of the National Advisory Committee it was the consensus that the Office of Education should not be concerned one way or the other, but that this was a matter for decision by each institution. This opinion was in line with the general principle that the Office of Education should respect the integrity of the colleges and refrain from any attempt to dictate institutional policies.

As stated in chapter I of this volume, ESMWT was never intended to supplant or interfere with general technical and professional college education. Instead it was designed to provide specialized training to fit men and women for immediate employment in industries or Federal agencies serving the national defense. This objective resulted in courses which, in general, were quite different from courses in the same field offered by the colleges to their regular students. ESMWT courses were intended to emphasize the practical aspects of certain rather limited portions of a technical or scientific field, with only such time devoted to general theory as was necessary for a proper understanding of these practical applications. The objective was to provide training which would be immediately useful in industry by making available persons who could intelligently perform certain specific technical or scientific duties, though they might lack a broad general knowledge of the field involved. A regular college course in the same subject should be concerned primarily with general principles and the theories underlying the whole field and related fields, should contain enough examples of practical applications to illustrate and drive home the principles and theories, and should attempt to provide education which would give the student a good general knowledge of the subject matter involved, the ability to think and reason intelligently therein, and a foundation on which a small amount of practical experience

would give him satisfactory proficiency in a wide range of technical or scientific duties.

These differences in objectives and characteristics between ESMWT courses and regular college courses gave rise to serious doubts as to whether the majority of ESMWT courses should be considered as satisfactory substitutes for courses designed as parts of organized technical and scientific curricula. Such substitution was therefore, in general, discouraged, although a fixed policy did not seem desirable, since some such substitution might be advantageous from the standpoint of defense.

In May 1941 a letter was sent to participating institutions reminding them that the completion of an EDT course should prepare a trainee for immediate employment in a defense activity, that he should be immediately available for such employment, and that for these reasons EDT summer courses should not be open to regular college students who planned to re-enter college in the fall.

In June 1941 the Committee on Engineering Schools of the Engineers' Council for Professional Development adopted the following resolution:

> The wide variety of courses offered under the EDT program and the quality of instruction achieved lead inevitably to consideration of college credit. The Committee on Engineering Schools of the Engineers Council for Professional Development is cognisant of the arguments advanced from the academic point of view for the granting of such credit. It recognises, however, that the primary purpose of this instruction is specialised preparation for national defense.
>
> In view of potential interference with the primary objective by modification of courses to permit academic credit and in view of the specialised character of the instruction, the committee recommends that, in general, credit be not given.

The Regional Advisers, at their fifth meeting in June 1941, discussed this recommendation and adopted a resolution stating that "it is the sense of this meeting that this group recommend to cooperating institutions that no college credit be given for EDT courses."

The "Answers to Questions" issued at the beginning of the ESMDT program contained the following statement:

> Only in special cases approved by the Director may anyone be admitted to an ESMDT course while he is enrolled as a regular college student. Such approval will not be given except for senior or graduate students who are pursuing programs of study in engineering, chemistry, physics, or production supervision. In such instances the ESMDT course must not be taken for college credit or as a substitute for a regular college course.

This requirement was found in practice to be somewhat too restrictive, and it was modified in January 1942 to permit students then in college to prepare themselves for employment in defense industries at the close of the college year. The new wording was as follows:

> Regularly enrolled college students may not be admitted to an ESMDT course unless they intend, upon completion of the course, to enter defense

employment or the armed forces and do not intend to re-enroll in college within the next academic year. In such instances the course must not be taken for college credit or as a substitute for a regular college course, except as this provision may have been specifically waived by the Director.

One exception was made to the general recommendation of the Washington staff that academic credit should not be given for ESMWT courses. This was in connection with the course in ultra-high-frequency techniques, originally offered during the second semester of the college year 1941–42. The only qualified trainees available for this course in numbers sufficient to meet urgent needs of the Armed Forces were the students already enrolled as seniors in regular college curricula in electrical engineering and physics, and it would have been impracticable for them to carry the course in ultra-high-frequency techniques in addition to their regular college work. Furthermore this course could properly be considered as having a place in these curricula, since it was organized in the same manner as a regular college course, and since the principles involved in this course would have wide application in industrial developments following the war, as well as immediate application in the development of radar equipment for the use of the armed forces. This course was given for credit because of the urgency of the need, and it is not considered that this action invalidates in any way the general policy previously quoted.

The final decision as to the granting of credit for ESMWT courses rests with each participating college, as does the decision as to whether or not such credit, if granted, shall be accepted as a substitution for parts of regular college curricula.

ESMWT PERMANENT INSTITUTIONAL RECORDS AND TRANSCRIPTS THEREOF

In the fall of 1944 the question was raised as to the propriety of using ESMWT funds for the establishment of permanent institutional records and for the issuance of transcripts in future years to ESMWT trainees. A letter to the participating institutions pointed out that they were required to give each trainee a certificate or statement covering each course which he had satisfactorily completed, and that this certificate or statement was comparable to the transcript which most institutions will issue without charge to each regular student. The opinion was expressed that the ESMWT trainee should expect to pay for additional transcripts an amount comparable to that charged the regular college student for a second or subsequent transcript.

It was brought out that such a fee could not be considered a proper charge against ESMWT funds, which were appropriated to pay the cost of courses, which cost could in no way be affected by the issuance or non-issuance of additional transcripts. All participating institutions were

therefore advised that charges against ESMWT funds for the issuance of transcripts to former trainees subsequent to the award of the certificate or statement of completion would not be approved.

The institutions were further advised that the cost of filing equipment necessary for the permanent filing of the records of ESMWT courses and trainees, and of transporting the equipment and records from the place of their use during the ESMWT program to the place of permanent filing, would be considered proper charges against ESMWT funds.

CLOSING THE PROGRAM

When it was decided that instruction in ESMWT courses should be terminated on June 30, 1945, telegrams were sent to all participating institutions announcing the decision in order that they might have all possible time in which to make the necessary revisions of their plans. Many institutions had already planned summer programs, and it was necessary that they revise their arrangements promptly in order to save needless expenditure of Federal funds.

The telegram was followed by detailed instructions covering courses already in operation, courses which could be completed before June 30, revisions of proposed courses with closing dates later than June 30, and necessary revisions of administrative budgets to cover the costs incurred in terminating the program.

Copies of these instructions were sent to the Presidents of participating institutions, to familiarize them with closing procedures contemplated by the Institutional Representatives and other officials who had responsibilities connected with the receipt and expenditure of Federal funds.

A short time later further information was sent to Presidents and Institutional Representatives, listing the various steps which should be taken by each participating institution to make certain that its records would be in satisfactory form for final audit. This was followed by a more detailed outline describing the documents which would be needed for a Federal audit, and containing instructions as to an inventory of equipment purchased and its location on June 30, class records, records of regional coordination costs, and other details in connection with the closing of the institutional programs.

On July 6, 1945, the institutions were notified of the provisions in Public Law 124, Seventh-Ninth Congress, First Session, which gave clear title to equipment and supplies bought with ESMWT funds, with the provision that "no school or school system shall be required to surrender possession or use of any property which it is using in its educational or training program."

The last meeting of the regional advisers, which was held on May 5, 1945, was devoted largely to a discussion of the procedures which would be

necessary in closing the program. Following this meeting each regional adviser held a meeting of the institutional representatives in his region, to which were invited the persons in each institution who were responsible for handling ESMWT funds. Each meeting was attended by a member of the Washington staff, who entered into detailed discussions with the institutional representatives as to the procedures they should follow in closing their institutional programs.

During the summer of 1945 every institution which had participated in the ESMWT program was visited by a member of the Washington staff. This visit was for the purpose of discussing details of the program and clearing up any uncertainties as to procedures with reference to the final report and as to records to be maintained in the institution.

Chapter IV

CONTRIBUTIONS TO THE WAR EFFORT

SINCE the ESMWT program was established to meet shortages in trained personnel in fields essential to the national defense, its results should be evaluated primarily in terms of the direct contributions it made to the national war effort, rather than in terms of its benefits to individual trainees. However, an industrial plant cannot be trained—the training must be given to the men and women who are or will be employed in the plant, and these people cannot be trained for more responsible tasks without being individually benefited by the training. It is therefore difficult to separate industrial benefits from personal benefits.

It is also difficult in many cases to evaluate with great accuracy the results of college-level training, which by its very nature does not lend itself to quantitative measurement. Such functions as design and supervision cannot be mathematically measured, and it is seldom possible to have available records of control groups to check against the records of trainees.

Nevertheless, it is possible to appraise ESMWT in terms of its objective of meeting shortages of trained personnel by a consideration of the nature of the training needs of war industries, of the character and amount of training conducted, and of specific instances in which definite benefits have been observed by industrialists. It is the purpose of this chapter to make such an appraisal, in the form of a small sampling of the contributions of ESMWT to the war effort.

INDUSTRIAL TRAINING NEEDS

Industrial concerns engaged in the war effort, large and small, were forced by the urgency of the great national need to expand their facilities rapidly and in some instances largely. Many small companies expanded in a short length of time to establishments of many times their prewar size. Many war plants were located in communities which previously had been predominantly agricultural, and which therefore had little or no backlog of men and women experienced in industrial production (as, for example, the large airplane factories built in certain parts of Kansas, Oklahoma, and Texas). Some concerns continued to make their normal product or something similar to it, which necessitated few changes in general manufacturing methods. Others on the contrary entered into the manufacture of war materials radically different from their normal products. In either case, a large training program was necessary. Complex operations had to be broken down into relatively simple elements to bring them within the occupational capabilities of the unskilled or semi-skilled employees being taken into the rapidly expanding industry. Experienced employees had to

be given special training to qualify them as supervisors responsible for the activities of groups of new employees. Women had to be trained to take the places of men called to the armed forces or upgraded to more responsible positions. Engineers and scientific personnel in the company had to be furnished with engineering aides and technical assistants so that they could concentrate their own efforts on the more responsible phases of their work.

Many of the large industrial concerns of the country had conducted training programs of their own for years prior to the war. Most of these concerns continued with their training programs during the war, but even such concerns found it advantageous to supplement their own training efforts with the services of ESMWT, because of the tremendous pressure of work on their executive and supervisory personnel. They found that ESMWT could give the needed training with less interference with actual production than would be caused if they conducted the training themselves.

In the case of the smaller companies, there generally was no training agency within the company, and in many instances there were not sufficient numbers of persons to be trained to justify conducting a course for them; but by combining the needs of several small companies and conducting ESMWT courses to fill these needs, the required training could be given adequately and economically.

CONTRIBUTION OF THE COLLEGES

The appraisive studies mentioned in chapter III of this history, together with the letters from industrial executives which continued to reach the participating institutions and the Washington office throughout the life of the program, leave little room for doubt that the institutions which participated in this program made an extremely valuable contribution to the war effort, by making available to war industries the services of more than one and one-half million trained persons qualified to do some particular technical or supervisory task needed in the war effort, who would not have been available without the training afforded by ESMWT. All studies of the placement of trainees made during the program indicate that nearly all trainees made direct use of their training in war industries. The spot check study which is described in chapter VIII, page 140, indicated that this percentage ran as high as 98.7 percent.

Table I presents in condensed form the over-all accomplishments of the program for each of the 5 years during which it operated, together with totals for the 5-year period. The 227 institutions which participated in the program enrolled 1,795,716 persons in courses preparing trainees for specific wartime jobs. This number included about 250,000 persons who received training in two or more courses, which makes the number of individual trainees somewhat over 1,500,000. However, since even

re-enrollments were for the purpose of training for specific war jobs, enrollments are referred to in this history as trainees.

Of the 1,795,716 trainees, 106,254, or not quite 6 percent, were enrolled in full-time courses, while 94 percent of the total training was for the purpose of upgrading persons already employed. The proportion of full-time trainees to the total enrollment was greatest in the first year of the program, constituting about 15 percent of the total for that year. The number of qualified persons available for full-time training declined rapidly during the war because of the needs of the armed forces and because of the increasing ease with which untrained people could find employment.

Table I.—Summary of EDT, ESMDT, ESMWT-I, ESMWT-II, and ESMWT-III Programs from October 9, 1940, through June 30, 1945—Institutions, Courses, Types of Trainees

Item	EDT	ESMDT	ESMWT-I	ESMWT-II	ESMWT-III	All programs
	1940-41	1941-42	1942-43	1943-44	1944-45	1940-45
1	2	3	4	5	6	7
Institutions which participated in program	143	194	214	195	172	227
Courses operated in: All fields	2,182	7,[illegible]	12,740	11,847	8,881	42,[illegible]
Engineering	2,182	6,174	9,537	7,850	4,725	31,405
Chemistry	0	220	480	437	298	1,433
Physics	0	132	231	270	238	871
Production supervision	0	1,072	2,502	2,981	2,344	8,799
Enrollment in: All fields	120,[illegible]	[illegible]	6[illegible],134	402,[illegible]	227,[illegible]	1,795,716
Engineering	120,602	380,564	442,928	265,365	186,555	1,327,[illegible]
Chemistry	0	7,914	12,929	10,654	6,231	[illegible]
Physics	0	5,512	11,998	8,020	5,984	[illegible],415
Production supervision	0	74,212	128,209	118,034	68,72[illegible]	387,[illegible]
Full-time courses	18,007	22,021	47,[illegible]	14,379	3,942	106,254
Enrollment of: Females	611	38,341	130,245	79,612	33,[illegible]	[illegible]
Negroes	949	2,985	10,539	7,574	2,981	25,1[illegible]
Armed forces	1,554	7,970	12,967	15,326	0	37,[illegible]
Veterans	0	0	0	6,094	8,221	14,315

The figures showing the number of courses operated require a word of explanation. As the term "Course" was used in the ESMWT program, it included all the training conducted by one institution under one approved course proposal. This might be limited to a single section or it might include as many as 100 sections in as many different locations. The figures in the table represent the number of course titles approved by the Washington office rather than the number of sections conducted. (See ch. VII, p. 102).

The table indicates that the heaviest demands for training continued throughout the program to be in the field of engineering, trainees in this field constituting about 74 percent of the total for the entire program. Trainees in courses in Production Supervision constituted 22 percent of

the total, while trainees in courses in chemistry and physics constituted about 2 percent each. A more complete break-down of enrollment by types of courses is contained in table II, page 48.

TRAINING OF SPECIAL GROUPS

NEGROES

The total number of Negroes trained in the program was 25,158. This number does not seem large in comparison with other figures in this table, but nevertheless it indicates a substantial contribution to the war effort. The number of Negroes who had adequate preparation for ESMWT training was proportionately smaller than the number of white persons with such training. These 25,000 men and women represent direct additions to the Nation's supply of persons with sufficient technical or scientific training to perform the professional and technical jobs in the war industries which ESMWT was created to fill.

So far as can be learned, the Negroes trained in ESMWT courses gave a good account of themselves in industry and contributed their full share to the industrial development of the country, which played such a vital part in winning the war.

ARMED FORCES

Because of the early ruling against training of enlisted personnel by ESMWT, the 37,816 trainees in the armed forces consisted largely of officers and civilian employees, a large proportion of whom were trained in the electronics program, which will be discussed later in this chapter. The training of this number of persons for technical services to the armed forces represented a valuable addition to the extensive training programs conducted by the armed forces themselves, although it constituted a small fraction of the total amount of training conducted by ESMWT. It should be borne in mind that ESMWT was designed primarily to aid war industries.

VETERANS

The number of World War II veterans enrolled in the program was small, but it will be noticed that it was larger under ESMWT-III than under ESMWT-II; while all other groups were smaller. This indicates that the training of veterans was only beginning to be effective when the program closed. It is well known that prior to V-E Day discharges from the armed forces were limited almost entirely to discharges for mental or physical disability of one sort or another, and it would hardly be expected that any large number of such veterans would be candidates for ESMWT training.

WOMEN

Approximately one-sixth of all trainees during the 5 years were women. The actual number was 282,235, which constituted an important and sig-

nificant addition to the Nation's pool of technically trained workers. The majority of these women represented real additions to the force of war workers, since most of them had not been previously employed, and almost none had been qualified to perform even the simplest of engineering or scientific tasks. Inasmuch as practically all of them found employment in war industries at jobs customarily assigned to men, the women trained in ESMWT courses released enough men from war industries to form an army of nearly 19 infantry divisions. The Italian campaign was successfully completed by 11 divisions!

Women were admitted to any ESMWT course on the same basis as men throughout the program. Some courses were established primarily for the training of women, such as the Junior Engineering courses at Rutgers University, and the full-time courses in Engineering Drawing at the University of California. At least one standard course outline, Junior Engineer–Supplemental (Number 25), was set up primarily for the training of women to be placed by the Civil Service Commission, although men were not barred from admission.

Considerable special effort was expended to encourage women to enroll in ESMWT courses. The Nation-wide cooperation of business and professional women's clubs was secured in the effort to acquaint women with the opportunities for service to the war effort which were opened to them. Jobs which ESMWT courses were designed to fill were not the kind of jobs women had customarily filled, and it required continual educational effort by the colleges to enroll the number of women trainees who were trained in the program.

It is the consensus of many letters received from the institutions which trained these women and of the industries which employed them that the results attained were well worth the effort. The general record of these women in industry is excellent—in many cases even better than that of men in similar positions. It seems evident that their training was a valuable contribution to the war effort.

ENROLLMENT, BY TYPE OF COURSE

Table II shows a breakdown of ESMWT enrollments into the main types of courses conducted under the program (compare list of courses approved by the chairman of the War Manpower Commission, page 30).

The field of engineering having the largest enrollment for the 5-year period was electrical engineering, in which about two-thirds of the trainees were enrolled in courses in communications and electronics, a program which will be discussed further in a later section of this chapter.

The second largest division of engineering was general engineering, 80 percent of the trainees in which were enrolled in engineering drawing and descriptive geometry, the largest single course in the program.

The third largest group in the engineering field was industrial engineering, in which the largest enrollment was in production engineering and safety engineering. If the enrollment in production engineering is added to that in industrial organization and management in the field of production supervision, some idea will be gained of the demand for advanced training for foremen and supervisors. This was one of the pressing needs of industry throughout the war and the training of people to fill these jobs was one of the highly significant contributions of ESMWT to the war effort.

Table II.—Total Enrollment for All Programs, by Type of Course

Type of course	EDT 1940–41	ESMDT 1941–42	ESMWT-I 1942–43	ESMWT-II 1943–44	ESMWT-III 1944–45	All programs 1940–45
1	2	3	4	5	6	7
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AERONAUTICAL ENGINEERING: Total	11,743	27,[illegible]	[illegible]	45,1[illegible]	[illegible]	1[illegible]
Fundamentals	1,410	1,515	3,591	4,543	1,921	12,980
Inspection and testing	2,121	4,146	5,294	5,554	1,942	22,187
Aircraft	1,354	1,955	4,232	1,960	1,028	10,529
Airports	341	747	642	136	0	1,[illegible]
Instruments	157	427	1,445	1,157	477	[illegible]
Power plants	713	2,105	2,610	2,628	3,373	10,439
Structures	4,713	9,648	15,469	15,903	7,023	55,736
Equipment	0	923	2,429	3,088	2,161	6,[illegible]
Other	934	6,024	14,845	9,961	3,729	35,477
ARCHITECTURAL ENGINEERING: Total	280	[illegible]	1,[illegible]	428	[illegible]	[illegible]
Fundamentals	26	331	165	129	0	661
Inspection and testing	0	0	71	0	0	71
Bombproof structures	196	5,039	182	0	0	5,417
Fire protection	58	328	444	207	64	1,101
Housing	0	[illegible]	173	90	32	967
Other	0	167	0	0	0	167
BASIC SCIENCES FOR ENGINEERS: Total	2,2[illegible]	21,747	31,[illegible]	27,[illegible]	17,14[illegible]	[illegible]
General	112	3,665	413	51	34	4,275
Chemistry	0	1,362	191	89	301	1,943
Mathematics	1,976	14,146	[illegible]	[illegible]	16,[illegible]	[illegible]
Physics	147	2,534	1,196	756	506	5,138
Other	0	40	0	0	0	40
CERAMIC ENGINEERING: Total	[illegible]	139	[illegible]	[illegible]	14	[illegible]
Fundamentals	0	139	45	0	14	199
Inspection and testing	0	0	0	0	0	0
Other	0	0	0	0	0	0
CHEMICAL ENGINEERING: Total	[illegible]	11,[illegible]	12,[illegible]	[illegible]	7,[illegible]	[illegible]
Fundamentals	440	3,[illegible]	2,872	1,[illegible]	671	7,7[illegible]
Inspection and testing	1,176	[illegible]	[illegible]	[illegible]	122	3,1[illegible]
Electro-chemical	87	214	141	[illegible]	177	1,150
Explosives	2,487	2,[illegible]	1,[illegible]	[illegible]	[illegible]	7,[illegible]
Petroleum	86	[illegible]	1,[illegible]	1,[illegible]	1,[illegible]	[illegible]
Production	795	1,[illegible]	1,[illegible]	1,457	[illegible]	[illegible]
Plastics	[illegible]	1,[illegible]	3,780	[illegible]	3,[illegible]	15,[illegible]
Stoichiometry	0	112	30	107	97	346
Other	135	1,146	1,196	870	[illegible]	3,[illegible]

Table II.—Total Enrollment for All Programs, by Type of Course—Continued

Type of course	EDT 1940–41	ESMDT 1941–42	ESMWT-I 1942–43	ESMWT-II 1943–44	ESMWT-III 1944–45	All programs 1940–45
1	2	3	4	5	6	7
CIVIL ENGINEERING: Total	7,887	22,911	21,891	11,270	7,229	70,[illegible]
Fundamentals	63	1,572	2,083	1,601	1,082	6,321
Inspection and testing	746	900	561	222	75	2,504
Foundations	353	401	694	551	163	2,162
Hydraulics	107	775	677	679	669	2,907
Sanitary	730	2,588	1,874	973	420	6,585
Structures	2,617	4,300	4,022	2,906	2,457	16,300
Surveying and mapping	2,770	9,427	10,364	3,855	2,273	28,688
Transportation systems	221	1,308	272	172	30	1,993
Other	0	471	374	373	121	1,338
ELECTRICAL ENGINEERING: Total	7,879	86,280	94,239	49,869	34,349	[illegible]
Fundamentals	1,721	6,877	4,062	4,348	2,209	19,217
Inspection and testing	380	589	653	563	248	2,440
Communications	2,018	40,745	64,254	19,446	9,433	135,906
Electronics	1,152	5,077	22,640	15,069	15,089	59,965
Illumination	74	175	95	322	267	917
Instruments	149	285	325	380	402	1,411
Power generation and transmission	1,267	10,187	11,631	9,468	6,270	39,013
Other	209	411	490	204	251	1,614
GENERAL ENGINEERING: Total	27,859	60,469	72,829	31,749	15,082	207,916
Fundamentals	5,876	8,732	9,949	3,863	1,606	30,026
Engineering drawing and descriptive geometry	21,200	49,574	60,350	25,937	12,192	169,313
Spectroscopy	125	0	0	0	0	125
Other	299	2,163	2,530	1,946	1,222	8,160
INDUSTRIAL ENGINEERING: Total	20,894	47,130	57,789	34,228	24,857	184,877
Fundamentals	400	442	1,089	692	436	3,059
Industrial management	1,968	2,704	824	91	949	6,536
Production engineering	11,462	24,275	22,697	16,158	12,622	87,118
Production supervision	6,262	3,746	5,573	1,344	1,333	18,278
Safety	604	15,431	26,096	15,700	9,606	68,441
Other	147	531	1,686	249	60	2,678
MARINE ENGINEERING AND NAVAL ARCHITECTURE: Total	3,239	8,789	12,289	11,473	6,989	40,782
Fundamentals	411	4,052	2,862	971	348	8,644
Inspection and testing	0	15	0	129	31	175
Hulls	1,985	2,989	5,365	3,057	3,004	16,380
Equipment	510	1,475	3,242	4,170	2,104	11,501
Power plants	273	751	570	1,891	1,626	5,111
Other	157	563	240	675	276	1,951
MECHANICAL ENGINEERING: Total	24,449	68,484	65,217	28,927	15,889	178,[illegible]
Fundamentals	3,015	4,670	3,004	1,951	818	13,468
Inspection and testing	7,573	19,836	19,463	5,610	2,076	54,548
Automotive	21	67	0	0	0	88
Heating, ventilating, and refrigeration	479	380	853	1,404	1,934	5,209
Internal combustion engines	670	2,835	4,987	1,957	695	11,447
Machine design	5,804	4,962	2,742	2,273	2,175	17,916
Steam power	362	1,575	2,036	1,574	690	6,[illegible]
Tools and dies	4,060	12,939	13,391	6,573	3,645	41,[illegible]
Welding	300	3,367	3,361	2,694	1,199	11,[illegible]
Other	465	2,697	5,309	2,041	2,036	12,[illegible]

Table II.—Total Enrollment for All Programs, by Type of Course—Continued

Type of course	EDT	ESMDT	ESMWT-I	ESMWT-II	ESMWT-III	All programs
	1940-41	1941-42	1942-43	1943-44	1944-45	1940-45
1	2	3	4	5	6	7
METALLURGICAL ENGINEERING: Total	8,764	20,636	18,875	10,382	5,903	64,[illegible]
Fundamentals	374	952	361	158	267	2,112
Inspection and testing	1,744	7,170	5,108	1,810	568	16,394
Heat treatments	222	1,404	1,812	2,085	812	6,335
Metallurgy and metallography	5,073	6,688	8,150	5,094	2,818	27,742
Physical metallurgy	1,149	3,112	2,089	978	887	8,135
Other	202	1,320	1,480	267	621	3,890
MINING ENGINEERING: Total	200	1,082	247	89	28	1,[illegible]
Fundamentals	27	300	0	36	0	3[illegible]
Inspection and testing	0	0	27	0	0	27
Coal	80	625	112	23	7	8[illegible]
Ferrous	34	52	0	0	0	86
Non-ferrous metals	29	48	28	0	0	105
Other nonmetallic minerals	0	0	38	0	0	38
Other	21	67	42	30	21	181
OTHER ENGINEERING: Total	1,079	2,190	[illegible]	[illegible]	710	5,782
COURSES FOR INSTRUCTORS: Total	0	0	6,425	2,840	629	9,894
CHEMISTRY: Total	0	7,814	13,029	10,984	6,331	38,[illegible]
Fundamentals	0	2,036	3,594	1,226	820	6,616
Analytical	0	3,292	7,158	4,336	2,001	16,787
Inorganic	0	82	130	277	95	[illegible]
Organic	0	1,280	3,056	2,738	1,508	7,540
Physical	0	580	837	887	280	2,584
Biological	0	174	326	296	97	893
Other	0	500	879	1,304	1,421	4,104
PHYSICS: Total	0	5,813	11,898	8,689	6,094	32,416
Fundamentals	0	298	580	454	465	1,[illegible]
Instruments and measurements	0	572	906	768	575	2,[illegible]
Mechanics	0	111	0	220	112	443
Heat	0	0	0	0	0	0
Electricity and magnetism	0	3,437	9,340	6,400	4,[illegible]	23,[illegible]
Light	0	779	284	574	2[illegible]	1,[illegible]
Sound	0	119	128	48	0	2[illegible]
Other	0	4[illegible]	755	1,2[illegible]	551	2,071
PRODUCTION SUPERVISION: Total	0	74,212	128,299	113,894	68,723	387,[illegible]
Industrial organization and management	0	11,474	24,795	36,009	23,211	95,489
Accounting	0	24,862	37,711	27,642	12,538	102,753
Office management	0	3,782	5,648	4,780	2,089	16,299
Personnel administration and labor	0	24,890	41,477	33,[illegible]	21,576	121,281
Employment management	0	120	0	0	17	137
Statistics	0	2,058	3,[illegible]	4,708	3,441	14,[illegible]
Procurement and stores	0	2,220	4,[illegible]	2,770	[illegible]	10,[illegible]
Traffic management	0	1,431	5,[illegible]	7,097	4,[illegible]	18,[illegible]
Other	0	2,785	2,[illegible]	1,415	[illegible]	7,[illegible]

The 10 individual courses which enrolled the largest number of trainees during the 5-year period were: Engineering drawing and descriptive geometry, 169,313; Communications, 125,996; Personnel administration and labor, 121,281; Accounting, 102,753; Industrial organization and management, 95,489; Mathematics, 88,764; Production engineering,

87,115; Safety, 66,441; Electronics, 59,995; Aeronautical structural engineering, 55,756.

A detailed examination of table II shows that in many of the individual subjects the rise and fall of enrollment approximately paralleled the rise and fall of the total enrollment in the program. However, there are other courses in which the changes in enrollment departed widely from the pattern of the program as a whole. In some subjects the enrollment developed quite rapidly in the early days of the program, while in others the maximum enrollment was not reached until quite late in the program. For instance, most of the civil engineering subjects reached their maximum enrollment rather early in the program, while new plant construction was heavy. In later months, when construction work had been largely completed, the enrollment in these courses fell off much more rapidly than in other fields. These departures by individual courses from the pattern of the program as a whole can be taken as an indication that the program was responsive to changing needs of war industry. As was brought out in two of the evaluations discussed in this history (ch. VIII, pp. 131 and 133) the participating institutions kept in close touch with the changing needs of war industries and conducted courses in accordance with these changing needs.

SPECIAL PROGRAMS

A number of notable specific contributions to the war effort were made as a result of the conduct of special courses in the ESMWT program. Some of these are briefly outlined in succeeding paragraphs.

CHEMISTRY OF EXPLOSIVES

One of the earliest of these special programs, which has already been mentioned in this history (ch. III, page 24) was the program to develop quickly a large number of people with adequate special training in the chemistry of explosives. The demand for such people was so great in the early days of the defense and war effort that under EDT two classes for teachers of the subject were conducted, in which 33 college teachers of the subject were specially trained to conduct EDT courses in this field upon their return to their own institutions. Nearly 8,000 trainees were given instruction in this highly important field of preparation for war. Of this number nearly 78 percent were trained during the first 2 years of the program, and 95 percent within the first 3 years. All reports on the work of these trainees following completion of their courses leads to the conclusion that the contribution they made to America's war effort was an outstanding one.

SAFETY ENGINEERING

Another special program developed under ESMWT was in the field of safety engineering. The tremendous expansion of American industry

caused by the defense and war programs resulted in a rapid induction of new and inexperienced workers into industry. Their inexperience, combined with the drive for increased output, created conditions which greatly increased both the frequency and the severity of industrial accidents, and caused the loss of a tremendous number of man-hours of labor and a corresponding reduction in the productive capacity of the Nation. That this condition was early recognized by participating institutions is shown by the facts that the first course in industrial safety engineering was organized only 5 weeks after the opening of the first course in the program, and that within 5 months safety training courses had been started in 7 colleges located in 5 States.

A joint committee representing the U. S. Office of Education and the U. S. Department of Labor in the spring of 1942 studied the courses in safety engineering then being given under ESMDT, and other course outlines and text materials, and developed ESMDT standard course outline 13, Industrial Safety Engineering, which was approved by the Office of Education and sent to participating institutions as a guide to aid them in organizing courses in safety engineering. These courses were to be set up to train supervisors, who would, in turn, assume the responsibility for carrying safety instruction into their plants. This program was so successful that it was later extended to cover personnel of the War and Navy Departments. In the fall of 1943, the program was still further expanded by offering a more advanced course in Industrial Safety Engineering (standard course outline No. 27). In the spring of 1944, still another course, standard course outline No. 29—Industrial Safety, was offered at the request of the National Committee for the Conservation of Manpower in War Industries.

The total enrollment in safety courses during the 5 years was 66,441, making it the eighth course in size in the entire program. The contribution which the supervisors trained in these courses made to the conservation of human life and energy in war industries can never be directly measured, but it was tremendous.

ULTRA-HIGH-FREQUENCY TECHNIQUES (RADAR)

One highly important development during the war in which ESMWT played an important part was that of the radar schools. As early as May 1941, the National Research Council called attention to the urgent need for training in the field of radio and electronics. Even earlier, courses in electronics and communications had been offered under EDT. The electronics courses steadily became more important and turned more and more in the direction of ultra-high-frequency applications.

The vital place that the ultra-high-frequency radio beam would take in the war was recognized in the spring of 1941 when the Army Signal Corps

began sending groups of from 450 to 600 young officers to England for instruction in the field. This plan was scarcely well started before many difficulties were experienced and others foreseen.

On June 23, 1941, the first ultra-high-frequency course for the training of officers opened at the Massachusetts Institute of Technology under the sponsorship of EDT. Shortly thereafter, under ESMDT, a cooperative program for the joint training of both Army and Navy officers, utilising the staffs and facilities of Harvard University and the Massachusetts Institute of Technology, was developed.

Increasing training needs became apparent almost immediately, and a teacher conference was arranged at the Massachusetts Institute of Technology, which was attended by faculty members from 40 engineering colleges which had been invited to participate in the program.

This conference followed the pattern established in the program of training in the chemistry of explosives. The instructors who attended returned to their own institutions, where they conducted ESMDT courses in ultra-high-frequency techniques, using a course outline and other teaching material developed at the M.I.T. conference. In the fall of 1942, under ESMWT, a second conference was held at Massachusetts Institute of Technology which resulted in the addition of 25 institutions to the 40 previously authorised to conduct ultra-high-frequency courses.

Beginning in July 1943, the Army and Navy made direct contracts for the training of officers in this field. Up to that time, there had been trained in ESMWT ultra-high-frequency courses 2,587 Army and Navy officers and 203 civilian employees in research; and 110 faculty members of engineering colleges had received training which prepared them, in turn, to give instruction to several hundred senior students majoring in electrical engineering and physics, as well as to others.

Before UHF training could be undertaken by an individual, a thorough knowledge of the more elementary principles of radio was necessary, and this field was also covered by ESMWT courses. Both the elementary and advanced training needs became increasingly imperative until the complete radio program became a major undertaking of ESMWT. The total number of persons trained in the field of radio and electronics was about 185,000.

The complete story of the accomplishments in the field of ultra-high-frequency radio for our armed forces is not yet fully known. However, enough is known by the general public to make it certain that ultra-high-frequency radio was a major war tool. The contribution of the ESMWT training in electronics and UHF to the conduct of the war, and the total saving effected in lives, ships, and aircraft have been of great magnitude and importance. To ESMWT should go credit for the early recognition of great war needs in this field, for getting the major training program under

way, involving the cooperative action of the Army, the Navy, and various educational institutions, and, finally, for developing a training program in the radio field which will stand out, because of its magnitude and the far-reaching nature of its results, among the greatest single concentrated efforts in education.

QUALITY CONTROL BY STATISTICAL METHODS

An exceedingly important contribution to war production was made by the Nation-wide use of the course in Quality Control by Statistical Methods. This course was based on the Shewhart Control Chart for controlling and improving quality during production. It treated such problems as acceptance procedures and specifications and methods of sampling to insure maximum quality at minimum cost; it considered economic design factors and the proper setting of tolerances and other factors having to do with improved production procedure. The course was originally developed at Stanford University under ESMWT. The Office of Production Research and Development of the War Production Board cooperated with ESMWT in the conduct of instructors conferences and in introducing courses in other institutions throughout the country. Many instances were reported to the institutions and to the Washington office of outstanding benefits to war industries resulting from the application of the principles and procedures developed in this course. Quotations from a few such reports are: "Savings of $10,000,000 annually on one operation" (By an aircraft manufacturer); "The _____ Company is saving $800 on every bomber yet attaining better performance." Another airplane manufacturer "reduced its inspection force 80 percent, yet effected greater safety and improved quality assurance."

OTHER PROGRAMS

Space does not permit the discussion of other special programs and courses, such as the Diesel engineering courses for Naval officers, the training of Maritime Commission officers, the tool-engineering courses given on the west coast to aircraft industries, the Nation-wide offering of courses in time and motion study, training of supervisors, mechanical drawing, training of personnel for the Army Map Service, production illustration, and many other courses which made distinct contributions to the armed forces or to industrial production throughout the period of the program.

STATEMENTS BY INDUSTRIALISTS

Throughout the life of the program many letters written by industrial executives were received by the Washington office, either directly or through participating institutions, setting forth benefits to the war work

of their companies which had resulted from training conducted under ESMWT. It was seldom possible for an industrial executive to make a definite quantitative statement of the results of the ESMWT training program. It was never known what the trainees concerned might have done without the training, and it was seldom possible to estimate accurately what training the company itself might have been able to conduct had ESMWT not been available. Nevertheless, a large number of the letters received from industrialists make definite statements as to benefits to the war work of their companies resulting from the training. The following excerpts are illustrative of the statements contained in many of these letters. Other letters are quoted in chapter VIII.

A letter received from the vice president of a shipbuilding company reads in part:

> We have grown from a shipyard with less than 6,000 employees to one with more than 32,000 men in less than 3 years' time. Our supervisory staff has had to grow in proportion.
>
> ————. Primarily, EDT, ESMDT, and ESMWT have been concerned with training the higher brackets of our personnel, including the supervisory staff.
>
> To translate the value of these programs into dollars saved and arrive at anything like a real figure would, of course, be hard to do; but our man-hours per ship have steadily decreased in spite of the fact that we have continually been feeding green labor in at the bottom of the ladder. We believe that a large proportion of this has been due to the emphasis placed on the training of the supervisory personnel.
>
> Such courses as Power Plant Operation, Electrical Engineering courses, scientific courses in Naval Architecture for the use of the supervisory personnel have given our supervisors a technical training that is invaluable in connection with their practical work in the field. Foremost in all of these types of training conducted under this program have been our Foremanship Training classes in which we have graduated over 1,200 men working as supervisors here at the shipyard. We are particularly proud of this program.
>
> That this higher-type of training for supervisory men has been a positive factor in increased production can be shown by the fact that our foremen and department heads in the field today ask for nothing but the greenest type of men to keep their program going, for they have the confidence in their ability to handle their jobs, analyse their production needs, and teach the newer men the things that they themselves have learned through training programs. Were we to assume that this higher supervisory training program was responsible for only one-tenth of the savings that we have made during 1943's production period, we feel that we would be very conservative. The one-tenth saving on one ship would amount to 8,000 hours and on the year's program of 72 ships would amount to 576,000 hours, which amounts to practically three-quarters of a million dollars.
>
> Besides the immediate value of this program to shipbuilding during the war effort, we feel that our supervisory staff has become educationally minded with the result that we feel that in the postwar competitive period, our men will want to continue to increase their effectiveness by further technical training in connec-

> tion with their jobs. Being training conscious, they have encouraged the men under them to make better use of vocational training facilities. We feel that EDT, ESMDT, and ESMWT programs have been handled in an efficient and economical manner by Swarthmore College and hope that you will be interested in continuing this worth-while educational program in our district.

An example of the sort of contribution which ESMWT was able to make in the case of a new industry located in a previously nonindustrial area is contained in a statement from an aircraft company. After outlining the fact that this company, starting "from scratch" in a nonindustrial area and rapidly expanding into one of the major aircraft companies in the country, presented a real and complex training problem, the division manager said:

> The help of the ESMWT program and the Texas colleges and universities sponsoring these courses has been an important factor in our being able to train a sufficient number of technically skilled employees to keep up with our plant's rapid expansion of personnel. This is especially true in the fields of tooling and engineering.

He stated further that the institutional representatives of several institutions worked closely with the training director of the company in the development of an adequate training program, and that without this cooperation and intensive study of training needs between institutional representatives and the company the program of training would have been much retarded.

The supervisor of personnel of a company in Connecticut, in a letter to the Bridgeport Engineering Institute, which conducted courses under the supervision of Yale University, wrote:

> I should like to take this occasion to tell you that in my opinion, the conduct of these courses and their effectiveness surpassed our most liberal expectations. When the final score is in, it is believed that much of the productiveness of our war industries must be credited to the splendid training which civilians received in your program.

An engineer in charge of an engineering and consulting laboratory at Schenectady wrote in April 1945 as follows:

> Early in 1940 this laboratory was asked by the Army and the Navy to develop and produce special measuring instruments and devices and we have since been doing this continuously, and even at the moment at an accelerated rate.
>
> All of this work is of the highest grade and requires the best of technical ability. To aid in the actual production, we have brought in many young women and in the later days a considerable number of young men (4F and returned veterans). These have been continuously trained in the course in electro-mechanical techniques, under the auspices of the ESMWT.
>
> At the present time we have enrolled 60 young women and 40 young men and I can say with all certainty that a goodly share of the high quality output demanded in the instruments which these young women and young men have tested is due to the completeness of the training which they have received in this course.

Although our turnover is not large, still under the present conditions of working it is substantial so that a continuity of training is essential as long as we have orders for war production, such as we have now where not only do we have considerable backlog but new orders are coming to us.

The ESMWT Training Course has become such an integral part of our operations that to continue on with our work, our supervisors express a positive need for it.

The engineer in charge of Langley Field Aeronautical Laboratory, National Advisory Committee for Aeronautics, wrote as follows:

The work-load of this laboratory during the war, resulting from requests by the armed services, has been greater than we have been able to handle with the staff available. It has been impossible to acquire, train, and assimilate sufficient professional personnel. The laboratory has been forced to utilize some professional employees who have received their basic engineering training in fields other than aeronautics. The importance of the work and the acute shortage of competent personnel has prompted the Army to make available to the laboratory certain Air Corps personnel for assignment to the Air Corps Enlisted Reserve. The engineers in this category have been away from school and in many cases from engineering work for a considerable time, and, therefore, are definitely in need of the training in aeronautics which our experience has shown can be supplied through the University of Virginia's ESMWT program. An increase in the staff of approximately 700 employees by the end of this fiscal year has already been approved. The greater part of these men will be engineers who will undoubtedly require specific training in aeronautical subjects now or previously set up under the local ESMWT program.

On the whole, the results of this training have been very gratifying. Section heads and division chiefs have been well pleased and have noted that it has been possible to make work assignments requiring a knowledge of the broad aspects of aeronautics, which would not have been possible without such training. The program has been a distinct and worth-while contribution to the laboratory's success in providing the armed services with vital research results.

The War Manpower Commission Regional Director for Rhode Island wrote to the Dean of Rhode Island State College as follows:

We are pleased to note that the training being done by your organization is becoming more and more specific, with courses designed to meet definite needs of critical industries. No other training agency is prepared to do the training job in the technical and engineering field that ESMWT is doing today and in view of the serious curtailment of competent engineering graduates, this service to industry cannot be overestimated.

In conclusion, may I again commend you on the excellent job being done by your institution and trust that it is going to be possible for you to continue this work in full cooperation with the WMC Division of Training.

The superintendent of tooling of an aircraft company, wrote as follows:

Just a few lines to advise you of the splendid work that has been accomplished by the ESMWT . . . in the training of tooling specialists and tooling engineers to fulfill our tremendous obligations in the war effort.

At this time, due to manpower shortages caused by Selective Service, the allotment of manpower by the U. S. Employment Service and the reduction of

the total number of tooling employees in our program of increased efficiency, it becomes increasingly important that the scope of our fewer personnel be broadened. This broadening training implies continued ESMWT courses so that we may carry on critical tooling programs that are still imperative in our major plants.

The series of "Tooling for Mass Production" courses that were initiated ... last year have been of inestimable value and we sincerely trust that we shall have the opportunity of this training for those night shift employees who have not yet had the privilege of attending.

The continued cooperation of your office ... in fulfilling these training courses will be sincerely appreciated.

A letter from the plastics department of another company, after stating that education "cannot be measured in quantitative terms," states:

We can, however, assure you that these courses have been of very definite value to our technical men who have taken them.

These courses have been of value because they have presented chemical knowledge which is up to date thus enabling the recipients to increase the scope of their usefulness to our chemical industry.

This knowledge, because of its recency, has generally not appeared in standard chemical textbooks used in colleges. These courses have benefited both older experienced technical men to increase their usefulness in war production and have assisted recent graduates in chemistry in developing their maximum usefulness in their application to war work.

INTER-INDUSTRIAL COOPERATION

In the early days of the program many industrial executives laid stress on the need for "closed" courses, by which was meant courses conducted for the employees of a single company. This attitude was in some cases made necessary by the highly secret nature of the company's product, and was a condition which continued in some cases throughout the program. In many cases, however, this attitude was caused by industrial rivalries and the rather natural disinclination of one company to contribute to the general effectiveness of operation of a rival company.

However, as the country became more involved in the war effort, and particularly after Pearl Harbor, this attitude largely disappeared except in urgent cases of highly secret products. It became evident to these executives that their primary interest lay in the utmost possible expediting of the war effort by all citizens. The proportion of closed courses declined steadily and it became more and more common practice to organize classes from among employees of several competing firms. With a few exceptions, no restrictions were placed on the trainees to prevent them from discussing their company procedures in the ESMWT classes. The classes thus became general forums for the exchange of trade information, and this feature of the program was found to be of great value to the industries concerned.

The teachers of many of the ESMWT classes were men employed by the industries being served, which meant that an expert in one company often used his knowledge and his experience to improve the work of competing companies. One especially striking case may be mentioned to show the length to which this inter-industrial cooperation could be, and was, carried. A company in New Jersey was supplying aircraft accessories and parts to aircraft producers in many parts of the country. Part of the stock was purchased from other manufacturing concerns, packaged, and reshipped. Other items were manufactured in the machine shop of the company. Because of the nature of its operations, the company placed emphasis on warehousing, receiving, and shipping of vital aircraft products. The company was also designated as one of the metal storage units for the United States Government.

Because of wartime conditions the personnel of the warehousing division of the company were inexperienced and not acquainted with modern methods of handling large quantities of small parts. Delays and errors in processing vitally needed aircraft parts were frequent and the personnel director of the company appealed to Rutgers University, one of the institutions participating in ESMWT, for help through a training program.

In response to this request a course was organized for the personnel of the company, and a competing corporation loaned the man in charge of its warehousing division to be the instructor. As a result of this course many improvements were quickly noted in the efficiency of the personnel in receiving, shipping, and storing the aircraft parts, and orders received from other manufacturers and from Army and Navy installations were processed much more rapidly and efficiently.

The industrial good will generated by such procedures as have just been mentioned was probably not envisioned as an objective of the legislation creating ESMWT, but it is unquestionably one of the valuable "by-products" of the program.

GENERAL CONCLUSIONS

The contents of this chapter and the appraisals mentioned in chapter III constitute only a small sampling of the evidence as to the general effectiveness of the ESMWT program and of the contributions it made to the war effort through the training it conducted.

ESMWT made available to war industries thousands of men and women with specialized training and abilities, who were able to perform important technical and supervisory tasks vital to the war effort, and which they could not have performed without the training given them by ESMWT courses. It served to increase the efficiency of other thousands of employees and to expedite war production in hundreds of plants in all parts of the country. In fact without the aid furnished by ESMWT many

industrial plants would have been unable to make the valuable contributions which they did make to the war effort.

No estimate can be made of the number of American lives saved directly or indirectly as a result of the increased production of all kinds of materials needed by the armed forces which can be traced to the training received by industrial employees under the ESMWT program. All available evidence leads to the conclusion that the program made a contribution to the Nation's war effort many times greater than the total amount expended in the conduct of the program.

Chapter V

PERMANENT EDUCATIONAL VALUES

THE PROGRAM outlined in preceding chapters contained many new concepts, many departures from the traditional. New relationships were established between Government and the colleges, and between the colleges and industry. More than one and a half million citizens received direct, practical, personal demonstration of the value of adult education. Industry discovered that the colleges could give thoroughly practical help in the training problems faced by companies that were rapidly expanding to meet war needs. The colleges learned new techniques of course construction and of teaching which proved to be successful in providing technical and scientific training to meet specific industrial needs. Even before the close of the program many industries were planning to continue similar training courses, either in their plants or in nearby colleges; and many colleges were planning continuations of ESMWT courses as technical extension services on a fee basis.

In short, it is evident that the results of this cooperative effort of the Federal Government and the colleges contain many implications for education and many permanent educational values to the colleges, to industry, and to the Nation.

It is the purpose of this chapter to list some of these implications and permanent educational values, and to discuss briefly certain of them. The chapter contains not only the ideas of the writer, but also his synthesis of opinions expressed by other members of the ESMWT Washington staff, members of the National Advisory Committee, Regional Advisers, Institutional Representatives, eminent educators, industrial executives, and others.

CONTINUING NEED FOR ESMWT-TYPE OF TRAINING

Experience during the war emphasized the fact that industry needs large numbers of well-trained technicians and subprofessional men and women to assist the fully trained professional workers—to serve as the "noncommissioned officers of industry." The ESMWT program demonstrated that these "noncommissioned officers" can be satisfactorily trained for their jobs in short intensive courses designed to fit persons for immediate practical duties.

ESMWT trained men and women for specific jobs in war industries, such as the production of airplanes, ships, guns, tanks, ammunition, and other war material. During the reconversion period and the period of prosperity which is expected to follow, it will be necessary to retrain many of these people and others to make automobiles, houses, household equipment, public buildings, highways, and to conduct other peacetime activities.

ESMWT and other programs have resulted in large numbers of partially trained engineers and supervisors in industry, which will create a large demand for further training of these men and women.

It is expected that postwar industries will demand of the colleges and universities more business and technical courses, more cooperative programs, more graduate courses, and more industrial research.

There seems to be every reason to believe that a program built on the principles of ESMWT, but designed to meet the peacetime needs of industry and governmental agencies for "noncommissioned officers" would serve an equally useful purpose and would provide benefits to the trainees, to industries and Federal agencies, and to the economic welfare of the Nation. It has been suggested that this program should be broadened to include all fields of education, at both the undergraduate and the graduate levels. Such a program might well include the training of governmental personnel, mostly on the postgraduate level.

TRAINING NEEDS OF VETERANS AND DISPLACED WAR WORKERS

Studies conducted by the Army Service Forces and experiences of educational counselors in many places have made it evident that many veterans of World War II will wish to continue their education, particularly in engineering and business courses, but that many of them, although fully qualified for college-level courses, will not wish to devote to their education the time required to complete regular 4-year college curricula. Rather, they will prefer courses similar in concept and nature to those conducted by ESMWT, in order to prepare themselves as quickly as possible for productive work. Many will wish to supplement training received in the armed forces with special upgrading courses to fit themselves for greater responsibilities and greater usefulness to industry. Many who held industrial positions prior to induction will need refresher courses to bring them up to date on the many changed industrial processes and procedures which have developed during the war. The need for this type of training is clearly recognized in many of the larger industrial organizations of the country, which are making definite provisions to give special training to former employees returning from the armed forces, in order that each one may be enabled to make his or her maximum contribution to postwar production. Essentially the same conditions prevail with respect to the retraining of industrial workers. Many will need retraining to convert them from occupations useful only in the war effort to occupations useful in a peacetime economy.

INCREASING THE IMMEDIATE INDUSTRIAL USEFULNESS OF ENGINEERING COLLEGE GRADUATES

It has long been recognised that the engineering graduate must be employable at the time of graduation. How to make him so when it is not certain which specific calling or employer he will have has been a major difficulty. Closer cooperation between the college and the industrial employer may find a more rational answer to this question and may make the transition from college to industry a smoother one. Possibly continuation training on the job through short, intensive courses following college graduation may be one means of increasing the immediate usefulness of engineering graduates, as ESMWT courses did for trainees already on the job.

REFRESHER COURSES FOR PROFESSIONAL WORKERS

ESMWT experience has shown that professional persons can have their industrial effectiveness enhanced by short, intensive refresher courses designed to bring them up to date on new developments in their fields; and that they can be prepared for work in new fields by short, intensive courses based on their previous general college and technical education and experience. It is felt by some persons that this type of instruction should be continued, mainly at the graduate level, to keep engineers and scientists informed of current developments in their professions.

NEED FOR NATIONAL COORDINATION OF TECHNICAL INSTITUTE PROGRAM

There is widespread agreement on the need for a great expansion of the technical institute type of training in the United States. Many believe that the Federal Government has an obligation in the development of this program, since if the technical institutes are to be successful, they must be adequately financed and must be established in such a way as not to conflict with already established public and private institutions. There should be a clear appreciation of the programs of other training agencies, particularly those offering vocational training. Technical institutes should cooperate with these agencies, but should be careful not to permit their courses to be conducted below the college level. National coordination seems necessary to accomplish these ends. Opinion has been expressed by many that experiences in ESMWT have indicated that it is possible for the Federal Government to administer large programs with a minimum of "red tape" and overhead costs, and that a joint endeavor of the character of ESMWT can be undertaken through cooperation between government and industry and still retain the essentials of free enterprise.

The National Advisory Committee of ESMWT on December 4, 1943, addressed the following resolution to the U. S. Commissioner of Education:

> The war has resulted in a rapid development of the type of training represented by the ESMWT courses. This may be designated intensive collegiate training for immediate application to industry and public service. It serves a much needed purpose and should be continued and developed.
>
> The relation between this type of training and professional education in engineering, science, and management is extremely close, and any administrative plan for its continuation must recognise these intimate relationships.
>
> If intensive collegiate training for immediate application to industry and public service is to be continued and extended, its Federal relationships can best be administered, in our opinion by assignment to the Division of Higher Education, U. S. Office of Education.

The Engineers' Council for Professional Development, which for many years has published lists of accredited engineering curricula, with results markedly beneficial to the engineering colleges, in 1944 established a Subcommittee on Technical Institute Programs, to accredit technical institute curricula on invitation of the institution offering them.

The Chairman of the subcommittee, Dean H. P. Hammond, of the School of Engineering, Pennsylvania State College, in announcing the program, said,

> The general purpose of the accrediting program is to raise the standards of instruction in the field of technical education intermediate between the engineering college on the one hand and secondary and vocational schools on the other, and to place this field of education on a basis of strength and usefulness comparable to the position it holds in other industrial nations. It is expected by this means to enhance the general status of technical and engineering education as a whole.

RELATIONSHIPS BETWEEN FEDERAL GOVERNMENT AND COLLEGES AND UNIVERSITIES

ESMWT set a pattern for relationships between the Federal Government and the colleges in a federally sponsored educational program, which many observers feel has important implications for the future. ESMWT was based on the fundamental policy of institutional autonomy and administrative responsibility to the greatest possible extent consistent with the responsibility placed on the U. S. Office of Education by Congress. The colleges planned and conducted courses to meet training needs uncovered largely by themselves, and the Office exercised a minimum of controls, adopting only such as were necessary to insure that the will of Congress should be carried out.

The opinion has been expressed by many of those who were active in the program, and also by many other educators, that this fundamental policy was an important factor in the success which attended the program, and

that it should form the basis for satisfactory relationships between the Federal Government and the colleges in any future federally sponsored programs in the colleges.

The Council of the Society for the Promotion of Engineering Education on October 25, 1943, adopted resolutions with respect to the postwar education of returning veterans, which included the following:

> 3. That, based on the very satisfactory experience of the engineering colleges conducting war training courses under the auspices of the U. S. Office of Education, it is felt that the general administrative policies and organization so successfully employed by this agency should be used as a prototype for the administration of Federal participation in the postwar education.
>
> 4. That the practice of the U. S. Office of Education of employing experienced engineering college educators and administrators in key positions on its administrative staff be adopted by any Federal agency charged with administering programs of higher education for returning veterans, involving engineering and related sciences.

INCREASED INTEREST IN ADULT EDUCATION

The more than one and one-half million men and women trained by ESMWT were enabled to make contributions to the national war effort which they could not have made without the training. These citizens had their morale raised by being provided with an impetus to self-improvement, by being helped to develop in themselves abilities and capacities inherent but often unsuspected, and through the satisfaction of knowing that their personal contributions to the war effort were increased in value and in effectiveness.

The success of ESMWT in preparing these people, of all ages and all walks of life, for effective participation in war industries has caused a tremendously increased interest in programs of adult education and a widespread appreciation of good teaching. It has been demonstrated that adults can be educated and that such education pays. Many men and women beyond school age have found that they can learn from texts and lectures things that they had given up as beyond their range, and they have enjoyed it. So many people have been benefited by these courses that it is inconceivable that the post-school-age group will give up this broadening type of instruction.

The program has also been responsible for an increased recognition on the part of the public of the need and value of night school and extension services by the colleges, to enable employed persons to prepare themselves for new positions or for greater effectiveness and increased responsibilities in their present positions. ESMWT had many aspects in common with extension programs, and some of the largest institutional programs were conducted by the extension divisions of the institutions concerned. A former president of the National University Extension Association

recently pointed out that of the 62 institutions holding membership in this association, 58 conducted ESMWT courses. Fifty of these institutions conducted courses off their campuses, and "at least 26" of the programs were administered by extension divisions. He pointed out further that in the ESMDT Program 8 institutions through their extension division trained about 34 percent of the total trainees for the year.

EFFECTIVENESS OF COLLEGES IN CONDUCTING INDUSTRIAL TRAINING

The opinion has been expressed by many that industry, governmental agencies, and the general public have acquired a greater appreciation of the effectiveness of college-level training and of the ability of the colleges to adapt themselves to changing needs and to render service of distinct immediate value to government and to industry.

Industry has learned through its experiences with ESMWT that the colleges can conduct the kind of courses needed by industry, more effectively than industry can conduct them for itself, and with less interference with production. Experience in ESMWT has demonstrated that operational jobs can be taught in the classroom and that such instruction provides an excellent preparation for the "noncommissioned officers" of industry. This is particularly valuable for groups of small industries in which it might be difficult or perhaps impossible to organize classes from any single industry large enough for effective and economical instruction.

However, experience in ESMWT has proven definitely that in order to be effective in preparing trainees for immediate usefulness in industry, courses must be designed through cooperation between the college conducting the course and the industry or industries being served. Careful and conscientious exploratory work as to training needs and thoroughgoing analysis of fields for essential training needs were found highly necessary to make the training effective.

VALUE OF COOPERATION BETWEEN COLLEGES AND INDUSTRY

The close and cordial cooperation which has been developed between the colleges participating in ESMWT and the industries and governmental agencies which they have served is considered to be highly beneficial to all concerned. In fact, the opinion has been expressed by many that this "byproduct" of the program might well be considered of sufficient value to justify its entire cost. There seems to be no doubt that both the colleges and the industries will make every effort to continue this cordial cooperation, which will enable the colleges to increase the value of their services to industry and to government and to give their students a type of education of increased value to them as workers and as citizens. This in no way implies that regular college curricula should be composed of ESMWT-type

courses, which, as has been previously noted, have a different objective from the regular college courses. One worker in the ESMWT Program characterized ESMWT courses as "discrete blocks of technical knowledge" and expressed doubts as to the feasibility of attempting to substitute a series of these "blocks" for an integrated program of education. The techniques developed in ESMWT will be of greatest usefulness in the development of instruction in technical institutes and in terminal courses in junior colleges, where they should prove extremely valuable. However, the general principle of maintaining close cooperation between the colleges and industry and of attempting to include in college courses consideration of the special problems of industries in order to enhance the immediate usefulness of college graduates to industry will undoubtedly be continued, to the great enhancement of the Nation's technical and scientific program.

INDICATED USEFULNESS OF "INDUSTRIAL PROFESSORS"—NEED FOR THEIR SUPERVISION

The successful use of industrial practitioners in specialized fields as teachers of ESMWT courses suggests the desirability of requiring a greater amount of practical experience of engineering and technical teachers, which, in turn, suggests the possible desirability of some arrangement whereby young staff members of our colleges can spend part of their time in industrial employment. It even gives rise to the suggestion that engineering and technical colleges might give thought to the development between themselves and practicing engineers and industrial technicians of relationships roughly equivalent to those existing between the colleges of medicine and the practicing physicians who serve as clinical professors. It is thought that the engineering and technical colleges may find it to their advantage to make use of a limited number of expert industrial practitioners who may come to be called "industrial professors." However, experience with ESMWT teachers recruited from industry has also shown the need for close and effective educational supervision over new teachers, and has given indications that such "industrial professors" may require rather careful educational supervision. This leads directly to the suggestion that technical and professional colleges might well consider the need for a greater degree of such supervision of new teachers in regular college courses.

IMPROVED TEACHING METHODS

Experiences of teachers in ESMWT courses have been helpful to the teachers, to the colleges, and to the industries. An increased interest has been developed among technical college teachers in improved teaching methods, such as a more effective use of visual aids, greater use of problem

material taken directly from industry (frequently from the industrial experience of the students), the use of longer class periods, and greater student participation in class discussions. The teachers have also learned the need, in instruction applied directly to specific jobs, for greater emphasis on practical applications of fundamental sciences without sacrificing basic principles. It has also been learned that in this type of instruction a strict adherence to the traditional prerequisites for regular college courses may be unwarranted. It has been demonstrated, for example, that alert adult persons can secure a sufficient working knowledge of technical subjects such as strength of materials, thermodynamics, and electronics to perform certain subprofessional duties in a very satisfactory manner, without being able to meet the traditional requirements of completion of a course in calculus. This suggests that future adult education may be organized on the principle of self-selection—on the basis of ability and energy instead of on academic credits previously earned.

CONTINUOUS APPRAISAL OF COURSE CONTENT AND TEACHING METHODS

ESMWT procedures necessitated careful study and review of the content of every course every time it was submitted for approval by the Washington staff, and its justification to that staff as a course which would definitely expedite the war effort. The close working arrangements developed between the colleges and industries served was another influence leading to a close and continuing appraisal of course content and of teaching methods, in an effort to make every course as effective as possible. The value of this continuous appraisal of courses and teaching methods has been so plainly evident to the colleges participating in the program that one result of ESMWT experiences will undoubtedly be an increased interest on the part of the colleges in making similar appraisals of regular college courses. Such a result cannot fail to have value to technical and scientific education.

INCREASED INTER-INSTITUTIONAL COOPERATION

The cordial relationships developed between institutions of higher learning as a result of their cooperative effort in the program, and the friendly discussions of common problems in regional and national meetings no doubt have been of great value to the institutions. The fact that the members of the National Advisory Committee, the Regional Advisers, the Institutional Representatives, and the members of the Washington staff knew each other and joined in effective teamwork led to a high degree of inter-institutional cooperation. New teaching techniques or improved course outlines developed by one institution were available to all partici-

pating institutions. Difficulties encountered in one part of the country were made known to all other areas and were not repeated. Solutions for difficult problems encountered in uncovering training needs, in finding suitable staff members, and in establishing satisfactory salary schedules, teaching loads, and administrative and supervisory procedures were passed on from one institution to others, resulting in definite benefits to the war effort. In some cases teachers were loaned by one institution to teach courses conducted by another institution.

It has been emphasized by many that these cordial relationships can and should be continued, and that they can contribute much to the general effectiveness of the Nation's educational program.

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PART 2

Part II

AUTHORIZATIONS, ORGANIZATION AND ADMINISTRATION, AND APPRAISALS

Chapter VI

CONGRESSIONAL AUTHORIZATIONS

IT IS THE PURPOSE of this chapter to quote the principal provisions relative to ESMWT which were contained in the seven Acts of Congress which appropriated funds for the program from 1940 to 1945.

EDT–1940–41

The Act which established the EDT program, Public Law 812 of the 76th Congress, 3d Session, was approved October 9, 1940. It included the following paragraphs relative to the EDT program:

> (3) For the cost of short engineering courses of college grade, provided by engineering schools or by universities of which the engineering school is a part, pursuant to plans submitted by them and approved by the Commissioner, which plans shall be for courses designed to meet the shortage of engineers with specialised training in fields essential to the national defense, $9,000,000: *Provided*, That only engineering schools which operate under charters which exempt their educational property from taxation shall be eligible to receive these funds: *Provided further;* That not to exceed 20 per centum of the amount allotted to any school shall be allotted to it for expenditure for purchase or rental of additional equipment and leasing of additional space found by the Commissioner necessary for carrying out its approved plan.
>
> The Commissioner shall carry out the purposes of these appropriations under regulations promulgated by him and approved by the President.
>
> No trainee under the foregoing appropriations shall be discriminated against because of sex, race, or color; and where separate schools are required by law for separate population groups, to the extent needed for trainees of each such group, equitable provision shall be made for facilities and training of like quality.

Regulations pursuant to the Act were approved by the President on October 22, 1940. They contained a statement of the general requirements for plans to be submitted by engineering institutions and a statement to the effect that courses must be for the purpose of preparing trainees for work in industries or occupations approved by the Advisory Commission to the Council of National Defense "as being industries or occupations

for the manufacture or maintenance or preparation of products essential to the National Defense or services needed in connection with the further development of plans for defense."

ESMDT–1941–42

The second year of the program was authorized in Public Law 146, Seventy-Seventh Congress, First Session, which was approved July 1, 1941. It provided for the expansion of the program into the new fields of chemistry, physics, and production supervision, and made definite provision for the cost of regional coordination, in the following paragraph:

> For the cost of short courses of college grade provided by degree-granting colleges and universities pursuant to plans submitted by them and approved by the Commissioner, which plans shall be for courses designed to meet the shortage of engineers, chemists, physicists, and production supervisors in fields essential to the national defense, and such plans may provide for regional coordination of the defense training program of the participating colleges and universities, $17,500,000: *Provided*, That only colleges and universities which operate under charters which exempt their educational property from taxation and public degree-granting educational institutions shall be eligible to receive funds herefrom: . . .

A ban on subversive activities by ESMWT employees, which was repeated in later Acts, was expressed in the following language:

> No part of any appropriation contained in this Act shall be used to pay the salary or wages of any person who advocates, or who is a member of an organization that advocates, the overthrow of the Government of the United States by force or violence: *Provided*, That for the purposes hereof an affidavit shall be considered prima facie evidence that the person making the affidavit does not advocate, and is not a member of an organization that advocates, the overthrow of the Government of the United States by force or violence: . . .

The Act contained the same statements concerning permissible allotments for equipment and space, and concerning discrimination as to sex, race, or color, as were contained in the act of the preceding year.

Provision was made for regulations to be promulgated by the Commissioner "under the supervision and direction of the Federal Security Administrator and approved by the President." This language was repeated in subsequent Acts.

Regulations pursuant to the Act were approved by the President on July 23, 1941. The regulations contained sections setting forth the functions of the National Advisory Committee and of the Regional Advisers, a slightly more detailed discussion of college plans than appeared in the regulations for the preceding year, and provisions for continued operation under plans approved during the preceding year until plans pursuant to the new Act could be submitted by the institutions and approved by the Commissioner.

These Regulations contained the first statement as to title to equipment purchased from ESMWT funds. The statement was that such equipment "shall be at all times held available for use in defense training courses and, to the extent not needed in the college, shall be subject to disposition by the Director for use elsewhere in the program. For these purposes title to the equipment shall be held by the college or its nominee."

These Regulations also contain the first reference to reimbursement for costs which could not reasonably be accounted for separately, stating that "the college may, subject to prior approval by the Director, charge to the cost of courses a percentage of definitely ascertainable costs. Any such percentage and a basis for application must be justified by such evidence as the Director may require."

ESMDT SUPPLEMENTAL APPROPRIATION

A supplementary appropriation of $3,000,000 was made by Congress in Public Law 528, Seventy-Seventh Congress, Second Session, approved April 28, 1942.

ESMWT-I, (1942-43)

For the fiscal year 1942-43, Public Law 647, Seventy-Seventh Congress, Second Session, approved July 2, 1942, appropriated $30,000,000 for the conduct of the program, using the same language which had appeared in the appropriation for 1941-42.

The Regulations pursuant to this Act were approved by the President on August 11, 1942. They contained no essential changes from the Regulations in effect during ESMDT.

ESMWT-II, (1943-44)

For the fiscal year 1943-44, Public Law 135, Seventy-Eighth Congress, First Session, approved July 12, 1943, appropriated $25,000,000 "for the cost of short courses of college grade—pursuant to plans—approved by the Commissioner, which plans shall be for courses of types approved by the Chairman of the War Manpower Commission. . . ." (The remaining language was the same as in the preceding act.)

The Regulations pursuant to this Act were approved by the President on September 28, 1943. The chief difference between these Regulations and those for the preceding year had to do with the responsibility of the program to the Chairman of the War Manpower Commission. It was provided that "courses must be of types approved by the Chairman of the War Manpower Commission." A further stipulation was made that "findings and recommendations of the appropriate War Manpower Commission authorities" should be considered by the Director in the approval of courses.

The statement concerning title to equipment which had appeared in previous Regulations was changed to specify that such equipment "shall be held by the college for use in war training courses, and shall be subject to transfer as may be required by the Director whenever and wherever in his judgment the need exists. For these purposes title to the equipment shall be in the college or in the name of an agency or an individual designee approved by the Director. Suitable measures shall be taken by the college to safeguard the continued availability of the equipment for the aforementioned purposes."

ESMWT–III (1944–45)

For the fiscal year 1944–45, Public Law 373, Seventy-Eighth Congress, Second Session, approved June 28, 1944, appropriated "$4,000,000, together with not to exceed 6 million dollars of the unobligated balance of the appropriation for this purpose for the fiscal year 1944, including repayments thereto—*Provided further*, That not to exceed 12½ per centum of the amount allotted to any school shall be allotted to it for expenditure for purchase and rental of additional equipment and leasing of additional space . . ." (Other language was the same as in previous Acts.)

No new Regulations were issued for the fiscal year 1944–45, but the institutions were merely notified of the one significant change from the preceding year, which was to the effect that 12½ percent of the amount allotted to any school might be allotted to it for the purchase or rental of additional equipment and leasing of additional space, instead of 20 percent as in previous programs.

LIQUIDATING THE PROGRAM

Public Law 124, Seventy-Ninth Congress, First Session, approved July 3, 1945, contained an appropriation—

> For all expenses necessary to enable the Office of Education to liquidate the program provided for during prior fiscal years under the head Education and Training, Defense Workers (national defense) . . . *Provided*, That equipment purchased during prior fiscal years from appropriations under the heading Education and Training, Defense Workers (national defense), in accordance with proposals submitted by educational agencies and approved by the Commissioner, shall remain the property of the agency designated in the proposal and approved by the Commissioner to purchase and to hold title to such equipment, and that the supplies authorized by the Commissioner to be purchased shall remain the property of the agency authorized to purchase such supplies: *Provided further*, That no school or school system shall be required to surrender possession or use of any property or equipment which it is using in its educational or training programs.

This provision as to the disposition of equipment and supplies purchased with ESMWT funds settled finally a matter which had involved uncertainty and had been of concern to the institutions and to the Washington staff throughout the 5 years of the program.

Chapter VII

ORGANIZATION AND ADMINISTRATION

THE PURPOSE of this chapter is to outline the general organization, policies, and procedures adopted by the Washington staff, the National Advisory Committee, Regional Advisers, Regional Representatives, and the participating institutions during the life of the program. The organization and the procedures were all designed with a view to expediting the accomplishment of the fundamental objective of the program—to conduct training "to meet the shortage of engineers, chemists, physicists, and production supervisors in fields essential to the national defense."

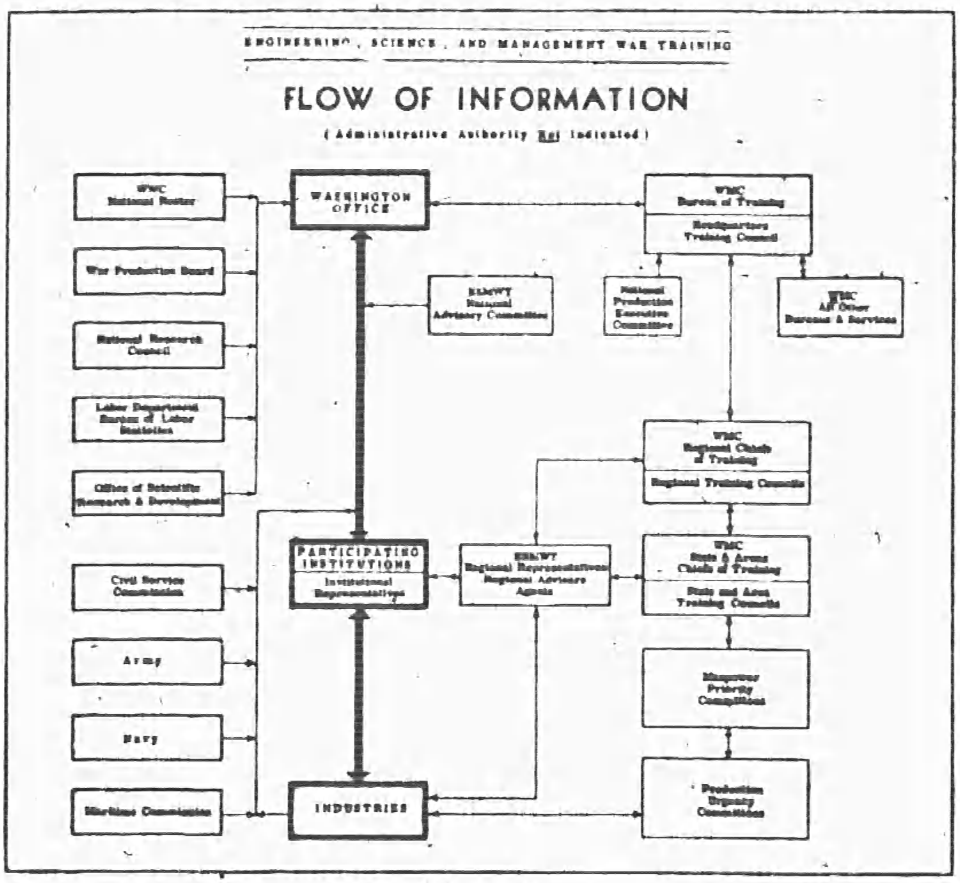

Figure 1

The most important factor in the general organization of administrative control of the program was the determination of local training needs to meet the urgent requirements of war production. The securing of information as to these training needs was the responsibility of the participating institutions. They obtained this information from a variety of sources which are indicated in Figure 1. "Flow of Information." This chart depicts

graphically the relationships which existed between the ESMWT Washington office, the participating institutions, and the industries and Federal agencies for which training was conducted. It also indicates the contacts maintained between ESMWT and other Federal agencies, especially the Bureau of Training of the War Manpower Commission. (See chapter III, page 28.) The chart shows only those agencies from which the greatest amount of information concerning training was secured.

As indicated in the chart, the principal sources of information as to training needs were the industries and Federal agencies for which courses were conducted. The colleges had for many years prior to the war maintained close contacts with industries and Federal agencies who employed their graduates. In the ESMWT program these contacts were strengthened and the cooperation between the colleges and industries became closer, since it was necessary for the colleges and industries to join forces in designing special training courses to meet special war needs, and in providing instructors to teach classes.

Other sources of information open to the institutions were the ESMWT regional advisers, regional representatives, National Advisory Committee, and the Washington staff, all of whom had many sources of information available to them concerning training needs. The regional representatives were in continuous contact with the War Manpower Commission Training Councils, who were, in turn, constantly studying the needs of industries in cooperation with the National Production Executive Committee and local Production Urgency Committees and Manpower Priorities Committees. Participating institutions were urged to make every effort to give all training needed in plants designated by these agencies as "must" plants.

The United States Civil Service Commission was particularly helpful during the earlier months of the program in advising regarding needs for engineering and scientific personnel.

The subject of determination of training needs will be discussed further in a later section of this chapter.

WASHINGTON STAFF ORGANIZATION AND OPERATIONS

The general duties of the Washington staff, in addition to the determination and establishment of general policies and procedures for the operation of the program, included (1) the approval of institutions for participation in the program, (2) the approval of course proposals and the keeping of records thereof, (3) accounting and auditing, (4) research and statistics, (5) publishing information and reports, and (6) cooperation with other Federal agencies.

As stated in chapter III, the Washington staff as constituted at the time of the passage of the original Act was quickly found to be too small to

administer the program effectively, and consequently it was augmented as suitable persons could be obtained.

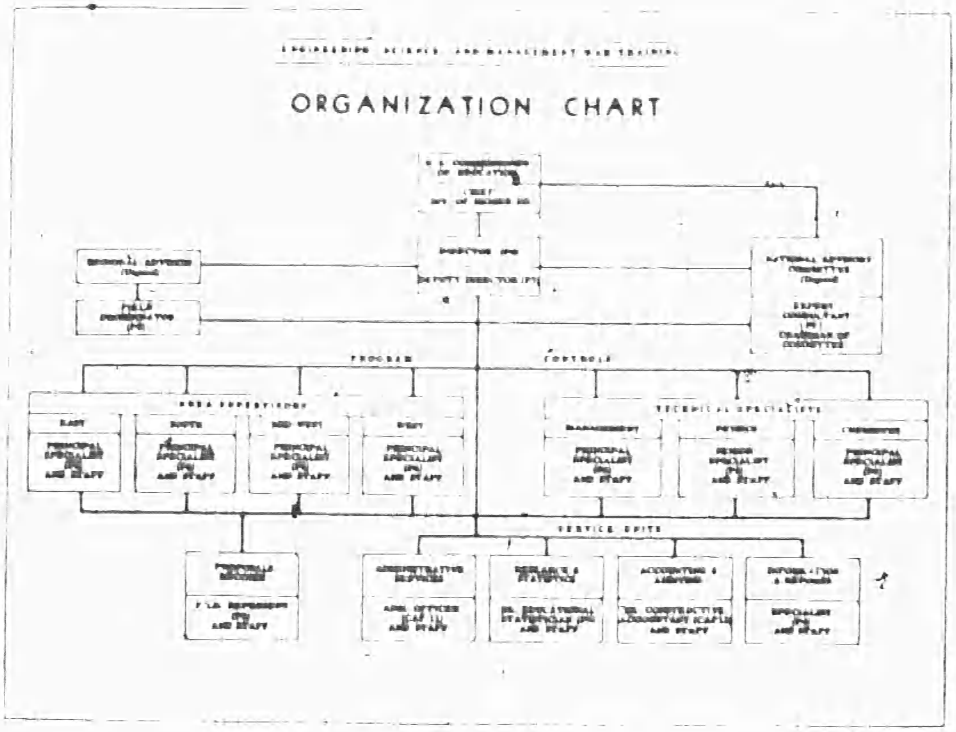

Figure 2

Figure 2 represents the organization of the Washington staff near the close of the program. It shows only the principal staff members in each division of the office, without specifying the number of assistants assigned to them. The composition of the staff was in a more or less constant state of flux, and it would be difficult to select any particular date on which the number of people employed in the various sections could be considered as an average number for the program.

In all divisions of the Washington office, extensive use was made of form letters, worksheets, and procedural charts and directions, in order to expedite the work of the professional staff members and to aid in the prompt processing of proposals and reports from participating institutions. A code system for identifying institutions and courses was set up early in the EDT program and used with slight modification throughout the 5 years of the program in preparing statistical and financial reports and as a quick and positive method of identifying courses and course proposals.

The duties listed above were performed by the units described in succeeding paragraphs, with responsibility centered in the director and deputy director.

PRINCIPAL STAFF MEMBERS APPOINTED

As outlined in chapter II, page 14, the original staff members, in addition to the expert consultant, who was also chairman of the National Advisory Committee, were Mr. Horton and Dean Case. Dean Seaton was appointed director of the program in November 1940, and other principal staff members were appointed from time to time, as will be outlined in the following paragraphs (listing appointments in approximately chronological order).

Prof. Henry H. Armsby, registrar and student adviser at the Missouri School of Mines and Metallurgy, was appointed field coordinator early in 1941, continuing in this capacity until the close of the program. His duties included coordination of the work of the regional advisers, through consultations with them and with institutional officials, attendance at regional meetings, and service as executive secretary for meetings of regional advisers. He acted as the personal representative of the director in public relations. After Mr. Horton's resignation from the staff, he also served as executive secretary to the National Advisory Committee.

The principal specialist's duties soon became so heavy that a second principal specialist was appointed, and the country was divided between the two men. The second principal specialist was H. M. Crothers, dean of the Division of Engineering, South Dakota State College, who joined the staff on leave of absence from his institution.

When the program was expanded in 1941 to cover the fields of chemistry, physics, and management, specialists in these fields were added to the staff. Dr. A. M. Patterson, formerly vice president and professor of chemistry at Antioch College, was appointed specialist in chemical education (later promoted to principal specialist in chemical education). When Dr. Patterson resigned in the fall of 1943, Dr. L. W. Hunt, associate specialist in engineering education, assumed his functions.

Dr. I. H. Solt, who had been a member of the staff since early in the EDT program, was appointed senior specialist in physics. Dr. Solt came to the staff with teaching experience in several engineering colleges, as well as industrial experience. He continued in this capacity for the remainder of the program.

Dr. G. T. Schwenning was appointed senior specialist in management education (later promoted to principal specialist). He came to the staff on leave from the University of North Carolina, where he was professor of business administration. He served until the end of the program.

Later in the year the number of the principal specialists was increased to three by the addition to the staff of Theodore H. Morgan, head of the Department of Electrical Engineering, Worcester Polytechnic Institute, who joined the staff on leave of absence from his institution. Mr. Morgan later served as assistant director, and still later as deputy director.

During the ESMDT program, Dean Case was promoted to the newly-created position of deputy director, to relieve the director of certain administrative duties by assuming general charge of the operations of the staff.

At the close of the ESMDT program Dean Seaton returned to his duties as dean of the School of Engineering and Architecture at Kansas State College, from which he had been granted leave to organize and develop the EDT and ESMDT programs. He was succeeded as director by Dean Case, who served in this capacity for the remainder of the program.

At this time Dean Crothers was promoted to the office of deputy director, which position he occupied until December 1943, when he returned to his duties as dean of engineering, South Dakota State College. He was succeeded as deputy director by Professor Morgan, who served in this capacity for the remainder of the program.

In May 1942, Prof. F. W. Marquis, chairman of the Department of Mechanical Engineering at Ohio State University, joined the staff as a principal specialist in engineering education, on leave of absence from his institution. He continued in this capacity for the remainder of the program.

At the close of the ESMDT program, A. C. Jewett, who had been serving as a field representative, was appointed principal specialist in engineering education, and served in this capacity for the remainder of the program. He had formerly served as the director of the College of Industries at Carnegie Institute of Technology.

Early in the fiscal year 1943–44, E. T. Donovan, who had been serving as a field representative, was appointed principal specialist in engineering education, to replace Mr. Morgan, who served as assistant director for a few months prior to his appointment as deputy director. Mr. Donovan served as principal specialist in engineering education for the remainder of the program. He had come to the program on leave as assistant professor of mechanical engineering, University of New Hampshire.

Mr. R. L. Peurifoy, who had been serving as a field representative, was appointed as the fourth principal specialist, and continued for the remainder of the program. Mr. Peurifoy came to the program on leave as the director of the division of engineering, Texas College of Arts and Industries.

APPROVAL OF INSTITUTIONS

The "Plan" submitted by an institution wishing to qualify for participation in the program was subjected to careful study by the technical specialists and the principal specialist in whose area the institution was situated, in order to determine in which field or fields the institution was qualified to conduct ESMWT courses under the terms of the Act and the Regulations.

Since the Plan was the basic contract between the institution and the Office of Education, a careful procedure was followed to insure that all professional members of the staff became acquainted with the qualifications of each institution approved for participation in the program, and with the conditions under which it was authorized to propose and conduct courses. The negotiations with institutions desiring to participate in the program, and the analysis of Plans were conducted by the principal specialist in chemical education. Later this duty was assigned to the field coordinator.

A total of 241 institutions were approved for participation in the program. Of this number, 96 institutions were approved in all four fields in the program; 8 for participation only in engineering; 19 for chemistry or physics or both, but not in engineering; and 4 approved to conduct courses in the field of production supervision, but not in engineering, chemistry, or physics. Thirty-four institutions were authorized to conduct courses in chemistry, physics, and production supervision, but not in engineering; 21 in engineering, chemistry, and physics, but not in production supervision; and 3 in engineering and production supervision, but not in chemistry or physics. Only 22 were authorized to conduct courses in but one of the four fields.

COURSE PROPOSALS AND RECORDS THEREOF

After an institution was approved for participation in the program it proceeded with its determination of local training needs by the methods which have been previously suggested and which will be further discussed in chapter VII, page 101. Courses were then designed to meet discovered needs and the institution submitted to the Washington office a preliminary proposal for each course it proposed to give. (See ch. III, page 22.)

The program was administered and controlled largely through the processing of these course proposals. The analysis and final action on proposals constituted an important part of the functions of the principal specialists on the Washington staff, who, acting under authority delegated by the Commissioner, were responsible for the approval or disapproval of course proposals. Allocation of funds to participating institutions was made on the basis of approved individual course proposals. The principal specialists advised institutions in many administrative matters, including the scope of their programs and the academic and financial controls necessary to assure that proper institutional and ESMWT standards were maintained in all courses.

The Washington staff was developed to contain four principal specialists, each of whom presided administratively over 3 of the 12 regions into which the War Manpower Commission divided the country.

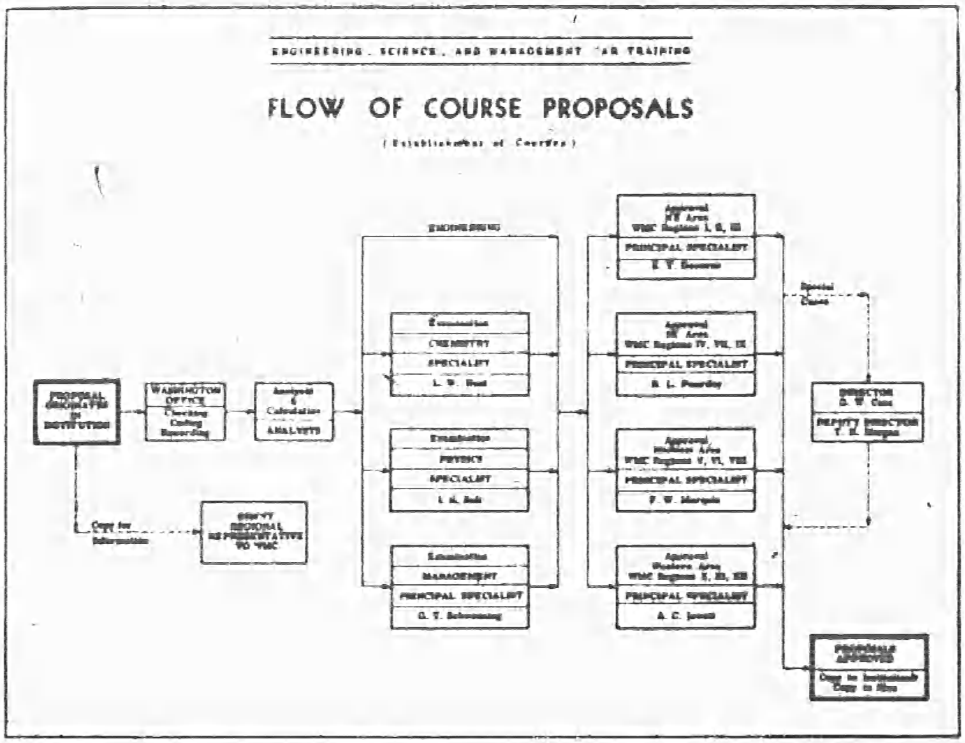

Figure 3

Figure 3 depicts graphically the flow of course proposals through the Washington staff and indicates the care which was exercised in the consideration of the proposals, in which the principal specialists were aided by the subject-matter specialists for courses in fields other than engineering and also by the work of the analysts who were attached to the office of the principal specialist.

In the examination of course proposals particular attention was given to the question of the existing or potential need for the course. Unless the statement of need contained in the proposal was sufficiently definite, or other information in the Washington office clearly indicated a need for the course, approval was withheld until the need was established.

It was required that each course be given under the educational supervision of a regular staff member of the department of the college normally teaching the subject represented in the course. The qualifications of instructors named in preliminary proposals were considered, and in some cases the institution was requested to secure instructors better fitted to give the training for which the course was designed.

Course outlines and the qualifications required of trainees were scrutinized to make certain that the course was designed to meet the stated needs and that it would be conducted on the college level. Institutions were asked to revise course outlines or to raise the qualifications required of trainees when such changes seemed advisable. After a course was started,

the registration forms filled out by the trainees were sent to the Washington office, where they were examined to make certain that the trainees enrolled met the qualifications stated in the proposal.

The cost of the proposed course was examined closely, taking into account such factors as the amount of work required to organize and design the course, the amount and kind of experience required of teachers, the size of the class, the length of the course, the special facilities in staff and equipment already available, and other pertinent considerations.

If a proposal indicated inadequate facilities or gave insufficient information in respect to one or more of the criteria mentioned above, correspondence was conducted with the college, resulting in either a modification of the proposal, its disapproval by the Washington staff, or its withdrawal by the college.

The principal specialists were also responsible for the examination and approval of proposals for administrative budgets and for working funds, and in the last months of the program, for the examination, auditing, and approval of final reports submitted by the participating institutions at the close of each year's program.

It was the intention that each principal specialist should have the assistance of a field representative, an analyst, and necessary clerical and stenographic personnel. A great deal of difficulty, however, was experienced throughout the program in the efforts to secure sufficient qualified personnel for the offices of the principal specialists so that they could function without definite overloads on the personnel.

The field representative visited participating institutions for consultation with the institutional representative and other officials, and represented the principal specialist at regional meetings. He also made the final examination of final proposals (preliminary proposals were examined personally by the principal specialist) for action by the principal specialist, and by conducting correspondence with institutional representatives relative to the final proposals. He also examined the registration forms of trainees enrolled in established courses and conducted necessary correspondence with institutional representatives concerning them.

Ledger records of administrative budgets and working funds were maintained in each principal specialist's office, as well as continuous records of the status of every proposal in its progress from receipt to approval, withdrawal, or disapproval. The accounting and auditing unit and the research and statistics unit were furnished with all information regarding proposals which were needed by them in the preparation of their studies and reports.

RESEARCH AND STATISTICS UNIT

The Research and Statistics unit was charged with the responsibility for collecting complete registration and enrollment data and preparing such

compilations and studies thereof as might be required. It aided in developing reporting procedures, forms, and records for purposes of effective administrative control, in proposing and conducting special analyses of statistical data for the use of the administrative staff, and in planning and carrying out research studies on the effectiveness of the training program.

This unit operated under the direction of A. H. Wieda, who transferred to ESMWT from the Vocational Division of the Office of Education, and later under Dr. Roy W. Bixler, who had served as registrar and director of admissions at the University of Chicago for a number of years, and had also maintained an office as an independent consultant in educational administration.

A simple but adequate system of records and controls was established, including five worksheets, and the use of punched card machine tabulating for certain parts of the work, which kept the unit constantly informed as to the completeness of enrollment reports received from the institutions, and which enabled it to prepare the various reports having to do with enrollment in ESMWT courses which were required during the course of the program.

A "Manual of Office Procedures" was prepared, containing instruction sheets covering all phases of the work of the staff in this unit. These instruction sheets were subject to continual revisions and improvements and the unit operated in a most effective manner.

The following regular reports were prepared by the Research and Statistics Unit:

1. Monthly Report on the Status of the Program (Enrollment figures for the month and fiscal year, by institution and date, and also by types of courses) was given general circulation with financial report prepared by the Accounting and Auditing unit.
2. Summary of Status of Program (Number of Institutions with approved proposals, number of approved proposals, enrollment in active and completed courses in the four main fields of the program) was originally issued each week, but later trimonthly, for the information of the Washington staff.
3. Monthly Enrollment Report to the Commissioner of Education (Enrollment for the month and fiscal year by institution and State, including the number of trainees who had concluded training and the number in training at the end of the period covered.) was sent to the Commissioner only.
4. Enrollment by States for the Commissioner's Quarterly and Semi-Annual Report (Cumulative enrollment records for the quarter and for the fiscal year, reported by States) formed partial basis for the Commissioner's Quarterly Report to Congress as required by the Act.
5. Summary of Enrollment Reports (Monthly) For use by Washington staff for general planning and for answering inquiries from governmental agencies and others. (Enrollment for month and cumulative since Oct. 9, 1940; active enrollment and new enrollment, including and excluding reenrollment, by months and programs, for all trainees, for women, and for Negroes).

6. Unit Cost Analysis (Annual or Semi-Annual) (Computation of costs per trainee hour by institutions and by types of courses) for the guidance of the Washington staff. This report was discontinued at the close of the ESMWT–I program.

A coding system was devised for quick and easy identification of the various reports issued by the Research and Statistics unit, either alone or in cooperation with other units in the office.

In addition to these regular periodic reports the unit made frequent special studies and reports, varying in volume and complexity, on its own initiative or on request from the Information unit or other units within the organization.

The statistical tables included in this history present a general over-all summary of the program as a whole. Detailed statistics are preserved in the Historical Collection in the U. S. Office of Education.

The Research and Statistics unit was of particular assistance to the National Advisory Committee, the regional advisers, and the institutional representatives, as well as to the Washington staff, by providing them at all times a picture of the developments of the program.

ACCOUNTING AND AUDITING UNIT

This unit classified and recorded the encumbrances set up to cover approved preliminary proposals, the disbursement of ESMWT funds as authorized in approved final proposals, proposals for working funds, and proposals for regional coordination, and the expenditures reported by the institution. A detailed record was maintained for each cooperating institution in which encumbrances, disbursements, and expenditures were classified into the principal accounts of (A) General Administration, (B) Instruction, and (C) Maintenance and Operation of Plant. Each of these accounts was subdivided into (1) Personal Services, (2) Equipment and Space, (3) Travel, (4) Consumable Supplies, and (5) Other Expenses. The provisions of the various Acts under which the program operated required that accurate records be maintained of encumbrances, disbursements, and expenditures for the purchase or rental of equipment and the renting of space. The final report submitted by each institution at the termination of each year's program was carefully audited to assure that all expenditures had been made in accordance with the provisions of the approved plan of the institution and of the course proposals approved as supplements to the plan.

The budgets proposed for individual courses were checked for accuracy and internal consistency, and vouchers prepared for certification to the Treasury Department for payment of funds to the institution.

The Accounting and Auditing unit prepared financial reports showing the allotments to and expenditures of the participating institutions.

The regular reports prepared by the Accounting and Auditing unit were:

1. ***Monthly Report on the Status of the Program***
   (Summary of Disbursements and Allotments for the month and fiscal year by main fields of the program, and until March 1, 1944, disbursements and unliquidated encumbrances by institution and States.)—Given general circulation with enrollment report prepared by the Research and Statistics unit.
2. ***Summary of Status of Program***
   (Net disbursements for courses in each of the four main fields and for the working fund.)—Originally issued each week, later trimonthly, for the information of the members of the Washington staff.
3. ***Monthly Financial Report to the Commissioner of Education***
   (Disbursements to institutions and expenditures by institutions for the month, obligated and unobligated balances in the institutions at end of month by institution and States, and cumulative for the fiscal year.)—This report was later made on the basis of total payment to institutions, unexpended balances in the institutions, obligations in institutions, and unobligated balance of entire appropriation, for the entire period from October 9, 1940, to the date of the report.—Reported to the Commissioner only.
4. ***Quarterly and Semi-Annual Report to the Commissioner of Education***
   (Summary of Disbursements to institutions for the quarter and fiscal year from all programs still active at the time of the report)—Partial basis for Commissioner's quarterly report to Congress as required by the Act.
5. ***Monthly Report of Funds Obligated but not Disbursed***
   (Changes in preliminary authorization during the month)—Reported to Administrative Officer, U. S. Office of Education.

The Accounting and Auditing unit also advised the institutions in regard to accounting procedures and through the services of Financial Field Representatives assisted them in setting up systems of accounts which would readily meet the requirements of the program.

This unit was under the direction of Dr. Henry L. Fulmer, senior constructive accountant, until September 1944, after which Genevieve O'Leary was promoted to fiscal accountant and remained in charge of the unit until the end of the program.

PUBLIC INFORMATION AND REPORTS UNIT

The primary function of this unit was to compile and disseminate information on the ESMWT program and to answer inquiries relating to it, in order to obtain a widespread knowledge of the availability of the training services, and to assist in the recruiting of adequate numbers of qualified trainees.

As stated in chapter III, page 18, it was from the beginning of the program a definite policy to issue general informational material from the Washington Office and from the participating institutions. These took the form of news releases, information bulletins, articles and addresses by staff

members, and local announcements of course offerings by institutions. The Information and Reports unit assisted in the preparation and editing of speeches and articles for presentation and publication by staff members and others, and in the preparation of news items of general interest. The unit also advised institutions in respect to their publicity and informational problems.

In heavily populated industrial centers, institutions cooperated in sending out such information by publishing in one bulletin or poster the announcements of the several institutions serving the area. This was true in the case of the three institutions serving the Pittsburgh area, which were: The University of Pittsburgh, Carnegie Institute of Technology, and Pennsylvania State College. Other examples are the cases of the institutions in the Boston area and those in the New York Metropolitan District.

Institutions were urged to send copies of all of public announcements to their regional advisers and to the Washington office.

The unit was directly responsible for the continual maintenance and periodic publication of a list of the titles of all courses approved for each of the participating institutions. It was also responsible for preparing the annual report required by law, a brief history of the operations and activities of the program during the year, which was incorporated into the annual report of the U. S. Office of Education. The unit was also assigned the duties of scheduling, correlating, and distributing the regular and special reports compiled by the Accounting and Auditing unit and the Research and Statistics unit, and of data secured from descriptive reports and the observations of field representatives. A news bulletin, which was originally issued weekly and later changed to a monthly publication, was issued by this unit and distributed to the advisory groups and the institutions.

This unit was originally headed by Robert B. Garrabrant, an engineering graduate of Cornell University with several years of industrial experience and several years as assistant editor and Washington correspondent with the McGraw-Hill publications, as well as a year's service as assistant director of the Joint Patent Inquiry of the American Engineering Council. Mr. Garrabrant resigned from the staff in April, 1942, and was succeeded by W. T. Clark, a graduate of Virginia Polytechnic Institute, who had had industrial experience with several large firms and who transferred to the ESMWT program from the Bureau of Employment Security. When Mr. Clark resigned from the program in the fall of 1944, his duties were divided between the deputy director and the field coordinator.

INFORMATION TO INSTITUTIONS

Throughout the program it was the policy of the Washington office to keep participating institutions fully and promptly informed of all impor-

tant developments in the program, new policies adopted, the deliberations of the regional advisers, and items of general interest concerning war industries and governmental agencies which it was felt would be of value to the institutions in connection with either their ESMWT programs or their regular educational programs.

This information was conveyed to the institutions by means of news bulletins, lists of titles of courses offered in the program by participating institutions, "standard course outlines," minutes of meetings of the regional advisers, monthly enrollment and financial reports showing the progress of the program in the several institutions, publicity material, annual issues of "Answers to Questions" and occasional revisions made necessary by new developments, forms and manuals for their use, and letters of general information concerning governmental and industrial developments of interest to the institutions.

STANDARD COURSE OUTLINES

As stated in chapter I, provision was made during the formulation of basic policies for the program for the preparation of "standard course outlines" by the Washington staff, to be used as suggestions and guides for the participating institutions in the design of courses for which a general need could be seen on a national basis, with the understanding that each institution should feel perfectly free to modify any of these course outlines to fit their own local needs.

The first 10 standard course outlines were sent to the institutions on October 18 and November 4, 1940, with a covering letter from the Commissioner in which he called attention to the fact that the standard course outlines were merely suggestive and ought to be revised to meet local conditions.

Other standard course outlines were prepared from time to time in the Washington office as the need arose for them. A complete list of such standard course outlines follows:

1. Machine design
2. Marine engineering
3. Materials' inspection and testing
4. Naval architecture
5. Production engineering
6. Production supervision
7. Tool engineering
8. Engineering drawing
9. Explosives
10. Aeronautical engineering
11. Chemistry of powder and explosives (Parts A and B)
12. (Never issued)
13. Industrial safety engineering
14. Ordnance inspection
15. Use of surveying instruments and surveying field procedures (I)
16. Use of surveying instruments and surveying field procedures (II)
17. Plane table topography
18. Topographic map drafting
19. Photogrammetry
20. (Never issued)
21. Ordnance inspection
22. Radio communication (Pre-radar)
23. Theory and practice of Diesel engine operation

24. Junior procurement inspector trainee
    Options in:
        Aircraft inspection
        Propeller inspection
        Engine inspection
        Instrument inspection
25. Engineering fundamentals (Junior engineer supplemental)
26. Qualifying mathematics for engineering courses
27. Industrial safety engineering (II)
28. Draftsman (Hydrographic Office, U. S. Navy)
29. Industrial safety
    Unnumbered courses:
        Fundamentals of radio (Part I)
        Fundamentals of radio (Part II)
        Correspondence course in mathematics for high-school teachers
        Correspondence course in physics for high-school teachers

FORMS AND MANUALS

The forms used in the program were kept as few in number and as simple in construction as possible, consistent with the principle that they should convey adequate information from the institutions to the Washington office and from the Washington office to the institutions. The forms were subject to continual appraisal as to their clarity, effectiveness, and conciseness, and were revised at the beginning of each successive fiscal year in the light of experience during the preceding year. The forms in use at the close of the program therefore represent the result of an evolutionary process extending over the life of the program.

To facilitate an understanding of these forms it was found advisable to issue general instructions covering their use. During the first 2 years of the program these instructions were incorporated into the "Answers to Questions" and supplements thereto, and in letters and miscellaneous releases. Beginning with ESMWT-I these instructions were assembled and published near the beginning of each fiscal year in a Manual of Forms and Procedures, which was supplemented as found necessary during the year by miscellaneous releases. Each annual issue of the manual contained complete instructions for the use of the forms for that year as of the date of issue of the manual, which made it unnecessary for the institutional representatives to refer back to preceding instructions.

A brief description of the forms in use at the close of the program follows:

(Numbers were assigned to forms as they were developed, merely for purposes of easy identification, and do not always conform to the chronological order of their use.)

Form 1–Preliminary Proposal.—The preliminary proposal was a report of a training need and a request that the institution be authorized to organize and begin instruction in a course to meet the need. It contained a statement as to the specific need for the course, a detailed outline of the course proposed to meet the need, the names and qualifications of teachers and educational supervisors, and detailed estimates of costs based on

(*a*) the number of trainees considered the minimum to justify a course; (*b*) the number of trainees which the institution desired to enroll, with the number of sections into which they would be divided; and (*c*) the maximum number of trainees which the institution was willing to enroll, with the resulting number of sections. Costs were classified under the three major accounts of (A) General Administration, (B) Instruction, and (C) Maintenance and Operation of Plant. Each of these accounts was subdivided into (1) Personal Services, (2) Equipment and Space, (3) Travel, (4) Consumable Supplies, and (5) Other Expenses. The total estimated cost of equipment and space was shown separately for easy reference, because of the limitation on such expenditures contained in the Act. The total "organization expense" was also separately itemized for reference in case the course should later be cancelled.

Provisions were made for the institution to supplement proposals by letters or telegrams requesting authority to conduct additional sections, to repeat a course after its original approval, to withdraw a preliminary proposal before approval, or to cancel an approved course, either with or without organization expense.

In addition to the copies of preliminary proposals and letter supplements submitted to the Washington office, the institution sent copies to its regional adviser and regional representative.

Form 1a–Course Authorization.—This form was used to notify the institution that a proposal had been approved, and to set forth the specific conditions of approval. Copies were sent to the regional adviser and regional representative.

Form 1b–Course Cancellation.—This form was used to notify the institution of the cancellation of a course, with the reasons for cancellation. Copies were sent to the regional representative.

Form 1c–Closure of Preliminary Proposal.—On this form the institution was notified that the record of a preliminary proposal had been closed in the records of the Washington office, either because of being withdrawn at the request of the institution or because the course was not approved by the director. In the latter case, the reasons for disapproval were stated. Copies were sent to the regional adviser and the regional representative.

Form 2–Proposal for Regional Coordination.—This form was submitted by institutions providing for regional coordination of the program through the services of a staff member as regional adviser and in some cases as both regional adviser and regional representative, or as a member of the National Advisory Committee. It contained an estimate of the expenses of such a staff member, divided into (1) Personal Services, (2) Equipment and Space, (3) Travel, (4) Consumable Supplies, and (5) Other Expenses.

Form 3–Plan for Short Engineering, Science, and Management Courses of College Grade.—This form constituted the basic contract between the institution and the U. S. Office of Education. It has been discussed in earlier sections of this history.

Form 4–Voucher.—This form was used by the Washington office to certify to the U. S. Treasury the amount of money to be transmitted to a participating institution to cover estimated costs of approved proposals from the institution.

Form 5–Final Proposal.—The final proposal was a report of a course in operation and a request for funds to cover its estimated costs. This form was almost identical with the preliminary proposal, except that only one budget was included, based on the actual enrollment in the course. This proposal was submitted after the course had been in operation for a week, and all information contained in it was based on actual operating conditions of the course.

Form 6–Monthly Financial Report.—On this form the institution reported to the Washington office at the end of each month its total expenditures during that month and during the fiscal year. Early editions of this form called for complete detailed expenditures based on the classification of costs used in preliminary and final proposals. Later this was found to be an unnecessary amount of detail and the form was simplified to contain merely the total expended by the institution during the month and year.

Form 7–Proposal for Working Fund.—The institution used this form to request that the Federal Government provide funds for temporary use to cover authorized expenditures pending the receipt by the institution of funds to cover the cost of courses as approved in final proposals.

Form 8–Registration Form.—This form, to be filled out by each trainee at the first meeting of each class, contained essential information about the trainee's previous education and employment and his plans for future employment. The information was used by the principal specialist to determine whether the class was composed of trainees qualified to meet prerequisites and whether the course would properly serve the war effort.

Form 9–Discontinued.

Form 10–Final Report.—This form constituted a summary of all ESMWT operations of the institution during a fiscal year. It contained information concerning all courses conducted by the institution and all payments it had made for personal services, equipment, leasing of space, building alterations, depreciation of laboratory equipment, and other items; a listing of total expenditures classified under the accounts used on preliminary and final proposals, and a statement of the balance returnable to the United States Treasury if the expenditures were less than the total

funds received by the institution during the year. An auditor's certificate was an integral part of this form.

Form 11–Opening Enrollment Report.—This form was used by the institution to report the opening of each section of each course and to report the enrollment at the first meeting, subdivided into those employed in war work and those not so employed. Information was also contained on this report as to the number of trainees paid by their employers for time spent in training, the number of female trainees, Negro trainees, and trainees who were veterans discharged since 1940. Information was also given as to the companies or agencies employing the trainees in the course. Two copies of the form were sent to the regional representative who forwarded one to the regional chief of training of the War Manpower Commission.

Form 12–Proposal for Administrative Budget.—This form constituted an explanation of the administrative organization and a preliminary estimate of administrative costs for the institution's program for a specified period not to exceed 5 months. The same division of costs was used in the preparation of this form as that used in preliminary and final proposals and the final report. The pro-rata cost per section was computed, based on the number of sections which the institution planned to conduct during the period covered by the proposal. These pro-rata costs, after approval, were used in subsequent preliminary and final proposals.

Form 13–Closing Enrollment Report.—This report was used by the institution to announce the closing of each section of a course and to report the total enrollment in the section, subdivided into new enrollment and reenrollment (trainees who had enrolled in previous ESMWT courses). The number who satisfactorily completed the course was stated, and available information given as to the reasons why the remaining trainees did not complete the course.

This form also contained such information as was known to the institution as to the employment or availability for employment in war work of the trainees of the section.

As on the Opening Enrollment Report, information was given as to the number of female, Negro, and veteran trainees in the section. A copy of this report was sent to the regional representative.

Form 14–Acknowledgment Card.—This post card form was sent by the institution to the regional representative with his copy of the preliminary proposal, and forwarded by him to the Washington office to indicate that he had received the proposal.

Form 15–Never Adopted.

Form 16–Report of Estimated Savings in Authorized Expenditures.—This form constituted a report of unexpended and unobligated funds available in the institution. It was submitted at stated intervals

during the year, with the savings divided into the general accounting divisions of (A) General Administration, (B) Instruction, (C) Maintenance and Operation of Plant, and (E) Equipment and Space.

COOPERATION WITH OTHER FEDERAL AGENCIES

Throughout the program the Washington staff maintained close liaison with other Federal agencies having training needs which could be met by ESMWT, or which were in a position to furnish information of value to the staff or to the participating institutions.

Three outstanding examples of cooperation between ESMWT and other Federal agencies were the development of the cooperative relations with the Bureau of Training of the War Manpower Commission, work with the War Production Board in obtaining priorities for equipment to be purchased by the institutions with ESMWT funds, and the cooperative program worked out with the United States Employment Service and the Veterans' Administration for the advising of veterans as to the training opportunities open to them through the ESMWT program. Of these three the first, cooperation with the War Manpower Bureau of Training, has been discussed in chapter III, and will be further discussed in a later section of this chapter.

On September 12, 1941, Director Seaton outlined to the institutions a procedure which had been worked out with the War Production Board under which the Office of Education could aid the institutions in securing delivery on orders for equipment to be purchased with ESMDT funds. This was the first of a series of communications sent to the institutions on the subject of priorities. A considerable amount of time was devoted by the professional staff to this matter.

Acting upon the suggestion of the National Advisory Committee, a cooperative program was developed between the ESMWT Washington staff, the Veterans' Administration, and the United States Employment Service, to make available to all veterans information concerning the training opportunities available to them through the ESMWT program. It was explained that veterans would be considered on exactly the same basis as any other trainee; that is, they were not to be considered eligible for ESMWT courses simply by virtue of their being veterans, but as prospective employees in war industries. The need for such a recruiting campaign was that men and women returning from the armed forces would probably have little knowledge of training opportunities open to them, and would be glad to learn of the chance to secure training to prepare themselves for employment in war industries.

A detailed poster was prepared setting forth the principal qualifications for admission, the types of courses offered, the kinds of jobs for which they prepared, the placement opportunities, and a list of the institutions offer-

ing courses under the program. This poster was distributed to USES Employment Interviewers, Selective Service Reemployment Committees, Army Posts and Camps, Hospitals, American Legion Posts, Veterans of Foreign Wars Posts, Chapters of Disabled Veterans, Veteran Placement Officers, Veterans' Administration Officers, and all ESMWT Institutional Representatives.

The number of veterans enrolled in ESMWT courses is shown in table I on page 45.

REGIONAL COORDINATION

NATIONAL ADVISORY COMMITTEE

As pointed out in chapter II of this history, the National Advisory Committee was organized prior to the authorization by Congress of the EDT program. It continued to function throughout the life of the program, providing advice to the Commissioner and the Director of the ESMWT program, to whom the Commissioner delegated many of the duties and responsibilities imposed by the Acts under which the program operated. The committee had no administrative authority, but it could and did make recommendations based on the contacts of its individual members with the participating institutions and with industry. Throughout the program there was close cooperation between the Commissioner, the Director, and the National Advisory Committee, and the recommendations of the committee as to policies, principles, and procedures in the program received careful attention. Its assistance in the early stages of the program in the formulation of basic policies, as discussed in chapters I and II, was especially valuable.

The Commissioner and the Director referred to the National Advisory Committee various problems with which they were confronted. They desired to have ESMWT a program of the institutions, not a Federal program in which only the facilities of the institutions would be used. The National Advisory Committee recognized the importance of maintaining this institutional responsibility, and supported it in its recommendations. The support of the committee also was helpful to the Director in his relationships with other Federal agencies.

The National Advisory Committee not only functioned in respect to the ESMWT program, but also concerned itself with other major problems incidental to higher education in a country forced to direct its best thinking to its war effort. In order to make up at least partially for the serious scarcity of fully trained engineers, and to assist the engineering colleges in rendering their maximum contribution to the war effort, the Committee took the lead in promoting an accelerated program of engineering education, which was adopted by practically every engineering college in the country. This program resulted in a material increase in the output

of engineering colleges during the most critical period of preparedness and war. It also gave to thousands of young people the mechanical and scientific training so essential in mechanized warfare, before they were actually inducted into the armed forces.

This committee was also helpful in focusing the attention of the public upon the importance of safeguarding and utilizing scientific and technological talents most effectively in the war effort. During the major portion of the period from 1940 to 1945 the National Advisory Committee was one of the best informed representatives in Washington of the engineering and scientific personnel of the country, and it made many recommendations of value to the Commissioner and other Federal officials with reference to major educational policies in the prosecution of the war effort.

Twenty-five meetings of the National Advisory Committee were held during the life of the program. These were helpful in formulating and clarifying general policies for the conduct of the program, and in a continuous appraisal of the results being attained. Members of this Committee made an effective contribution to the war effort through their services to the ESMWT program and the U. S. Office of Education.

The original members of the National Advisory Committee were:

ANDREW A. POTTER, dean of engineering, later acting president, Purdue University (chairman of the committee)
F. L. BISHOP, secretary, Society for the Promotion of Engineering Education
R. E. DOHERTY, president, Carnegie Institute of Technology
GIBB GILCHRIST, dean of engineering, later president, A & M College of Texas
H. P. HAMMOND, dean of engineering, Pennsylvania State College
W. O. HOTCHKISS, president, Rensselaer Polytechnic Institute
R. S. MCBRIDE, consulting engineer, Washington, D. C.
THORNDIKE SAVILLE, dean of engineering, New York University
C. C. WILLIAMS, president, Lehigh University
B. M. WOODS, chairman, Department of Mechanical Engineering, University of California (Later, director of University Extension)
ALLEN W. HORTON, JR., U. S. Office of Education (secretary of the committee)

All but two of the original members served on the National Advisory Committee throughout the life of the program. Mr. McBride resigned at the end of the ESMDT program due to press of private business. Dr. Hotchkiss resigned in the fall of 1943, when he became President Emeritus of Rensselaer Polytechnic Institute.

Following Mr. Horton's resignation from the Office, H. H. Armsby, Field Coordinator ESMWT, was elected by the committee to serve as its secretary. He served until the close of the program.

When the program was expanded to include the fields of chemistry, physics, and management, there were added to the original committee

representatives of the new fields. These men were:

C. E. GRIFFIN, dean, School of Business Administration, University of Michigan
H. L. DODGE, director, School of Engineering Physics, and dean of the Graduate School, University of Oklahoma (later director, Office of Scientific Personnel, National Research Council) (later president, Norwich University)
N. W. RAKESTRAW, professor of chemistry, Brown University

Dean Griffin resigned from the Committee early in 1944. Professor Rakestraw and Dean (later president) Dodge continued to serve on the committee for the remainder of the program.

Subsequent additions to the membership of the National Advisory Committee were as follows (Listed chronologically):

W. R. SPRIEGEL, head of Department of Management, Northwestern University
RUSSELL M. GRUMMAN, director of University Extension, University of North Carolina
R. A. SEATON, dean of the School of Engineering and Architecture, Kansas State College of Agriculture and Applied Science (appointed upon his resignation as director of the program)
DONALD K. DAVID, dean, Graduate School of Business Administration, Harvard University
H. M. CROTHERS, dean, Division of Engineering, South Dakota State College (appointed following his resignation as deputy director of the program)
C. C. BALDERSTON, dean, Wharton School of Finance and Commerce, University of Pennsylvania

Dean David found it necessary to resign from the Committee early in 1945. The other men named above continued as active members of the Committee throughout the remainder of the program.

REGIONAL ADVISERS

As stated in chapter III, regional advisers were appointed shortly after the passage of the Act authorizing the EDT program, to serve as liaison officers between the Office of Education, the engineering colleges participating in the program, and the industries and Federal agencies served by them, and to act as chairmen of regional committees composed of the institutional representatives of institutions within their respective regions. In the latter capacity they served not as chairmen who assigned or directed activities of the committee, but as advisers to the members of the committee. The regional adviser had no administrative authority, since the institutional representatives dealt directly with the Washington office with regard to the ESMWT activities of their institutions. It never seemed desirable to hold periodic meetings in Washington of all institutional representatives; instead, for reasons of economy and conference effectiveness, the regional advisers met frequently with their committees of institutional representatives. They were thus prepared to present to the Wash-

ington office current problems in their respective regions, and to take back to the institutions the current thinking of the Washington staff.

Twenty-two meetings of the regional advisers with the director and other members of the Washington staff were held during the 5 years of the program. The advice and counsel of this group were most helpful in the formulation of policies and the design and clarification of procedures, and in bringing about effective cooperation between the colleges and the Office of Education. The activities of the regional advisers greatly facilitated a two-way exchange of information which resulted in a clear conception of the program as an integrated Nation-wide cooperative enterprise of the colleges in aid of the war effort, and brought to the Washington staff important current information on local problems in the several parts of the country, and a continuous appraisal of the general effectiveness of the program in expediting defense and war production.

The men selected for these positions had the confidence and respect of their colleagues in the program, were intimately acquainted with each of the institutions in their respective areas, and rendered service of inestimable value throughout the program. In addition to transmitting to the institutional representatives the results of discussions at their meetings with the director, the regional advisers were a source of inspiration and help to the institutions. They avoided any attempt to decide administrative matters or to assume responsibility for inspecting or accrediting the work done in participating institutions. Rather, they acted as friends and colleagues, instead of supervisors, directors, or administrative officials. Their exercise of leadership in planning and conducting regional meetings, in sensing regional needs for training, and in suggesting ways in which specific institutions might be helpful in meeting these needs, contributed greatly to the success of the regional cooperation which was an important factor in the general effectiveness of the program. They contributed much to the general morale of the institutions by maintaining an active interest in the work of each institution in their respective areas, and by counseling on problems, especially in the case of new institutions joining the program.

The men who served as regional advisers during the program, each of whom was responsible for an area which included the institution to which he was attached, are listed below. Those marked with the (*) found it necessary to resign as regional advisers before the completion of the program, and were succeeded by those marked with the (†).

Regional Adviser	*Position*	*Institution and city*
*J. W. Barker	Dean of the Faculty of Engineering	Columbia University, New York, N. Y.
*J. D. Beatty	Head, Bureau of Industrial Relations	Carnegie Institute of Technology, Pittsburgh, Pa.
M. F. Coolbaugh	President	Colorado School of Mines, Golden, Colo.

Regional Adviser	Position	Institution and city
H. O. Croft	Professor of Mechanical Engineering	University of Iowa, Iowa City, Iowa
A. R. Cullimore	President	Newark College of Engineering, Newark, N. J.
R. L. Daugherty	Professor of Mechanical Engineering	California Institute of Technology, Pasadena, Calif.
H. B. Dirks	Dean, Division of Engineering	Michigan State College, Lansing, Mich.
†A. B. Domonoske	Professor of Mechanical Engineering	Stanford University, Stanford University, Calif.
†S. B. Earle	Dean, College of Engineering	Clemson College, Clemson, S. C.
†E. L. Grant	Professor of Economics of Engineering	Stanford University, Stanford University, Calif.
H. T. Heald	President	Illinois Institute of Technology, Chicago, Ill.
*S. C. Hollister	Dean, College of Engineering	Cornell University, Ithaca, N. Y.
*H. H. Langdon	Professor of Mechanical Engineering	State College of Washington, Pullman, Wash.
†A. S. Langsdorf	Dean, Schools of Engineering & Architecture	Washington University, St. Louis, Mo.
†C. E. Lawall	President	West Virginia University, Morgantown, W. Va.
†E. A. Loew	Dean, College of Engineering	University of Washington, Seattle, Wash.
C. E. MacQuigg	Dean, College of Engineering	Ohio State University, Columbus, Ohio
*J. R. McDaniel	Director, Cooperative Department	Georgia School of Technology, Atlanta, Ga.
*E. L. Moreland	Dean of Engineering	Massachusetts Institute of Technology, Cambridge, Mass.
*S. B. Morris	Dean, School of Engineering	Stanford University, Stanford University, Calif.
†A. B. Newman	Dean, School of Technology	City College of the City of New York, New York, N. Y.
D. B. Prentiss	President	Rose Polytechnic Institute, Terre Haute, Ind.
*R. A. Seaton	Dean of Engineering and Architecture	Kansas State College of Agriculture and Applied Science, Manhattan, Kans.
L. E. Seeley	Associate Professor of Mechanical Engineering	Yale University, New Haven, Conn.
*W. T. Spivey	Director, Evening Diploma School	Drexel Institute of Technology, Philadelphia, Pa.
S. S. Steinberg	Dean, College of Engineering	University of Maryland, College Park, Md.
*Blake R. Van Leer	Dean of Engineering	North Carolina State College, Raleigh, N. C.
†Joseph Weil	Dean of Engineering	University of Florida, Gainesville, Fla.

Regional Adviser	*Position*	*Institution and city*
†W. C. White	Dean, College of Engineering	Northeastern University, Boston, Mass.
F. L. Wilkinson, Jr.	Dean, Speed Scientific School	University of Louisville, Louisville, Ky.
W. R. Woolrich	Dean, College of Engineering	University of Texas, Austin, Tex.

During the first 2 years of the program some minor changes were made in the boundaries of the areas assigned to the regional advisers, and at the time that ESMWT was named as one of the agencies to comprise the War Manpower Commission Bureau of Training additional changes in boundaries were made so that the ESMWT regions would fit into the WMC regions. At this time two associate regional advisers were appointed. They were:

Associate Regional Adviser	*Position*	*Institution and city*
R. C. Disque	Dean, College of Engineering. (Later Acting President)	Drexel Institute of Technology, Philadelphia, Pa.
F. O. Holt	Dean, Extension Division (Later Director, Department of Public Service)	University of Wisconsin, Madison, Wis.

LOCAL COORDINATORS

In certain highly industrialized metropolitan areas which were served by several institutions, the institutions found it advisable to effect a closer degree of coordination of the program than was feasible through the usual regional committee. In some such cases the institutions employed coordinators to handle such matters as promotion and publicity, joint registration of trainees, designation of the institution to conduct a particular course, and the general coordination of all ESMWT training in the area.

In such cases the institutions provided the coordinator's office with an administrative budget, approved by the Washington office in much the same manner as the regular administrative budgets of the institutions, and pro-rated among them on some mutually satisfactory basis.

This procedure was found effective in preventing overlapping of activities by neighboring institutions and in promoting the over-all efficiency of the program in the area served by the coordinator.

REGIONAL REPRESENTATIVES

As stated in chapter III, when ESMWT was named as one of the agencies to comprise the Bureau of Training of the War Manpower Commission, 12 of the ESMWT regional advisers were appointed regional representatives to WMC. Each was to serve as a working member of a committee of training agency representatives under the chairmanship of the WMC

regional chief of training, to be chairman of a committee composed of the regional advisers whose regions comprised his WMC region, and to keep the WMC chief of training informed as to progress of the ESMWT program in his region. All contacts of the WMC regional chief of training with the institutions and the regional advisers were to be made through the regional representatives.

To keep each regional representative fully informed as to developments in the program within his region, it was arranged that each institution should send to its ESMWT regional representative copies of course proposals, requests for extra sections and for repetitions and cancellations of courses, opening enrollment reports, and closing enrollment reports. The Washington office also sent to the regional representative copies of course authorizations for courses in his region. The information contained in these documents was available to the WMC field staff through the office of the WMC regional director. The institutional representatives received information from the regional representative concerning training needs in his area which were conveyed to him by the WMC field organization. The ESMWT regional representative was authorized to appoint agents to represent him at meetings called by WMC regional, State, or area directors of training. Such an agent was authorized to vote on matters of detail but not on questions affecting ESMWT policies. He was expected to inform the regional representative of any proposed arrangement in which ESMWT might be concerned, and all such arrangements which would affect ESMWT administrative policy were to remain tentative until approved by the regional representative or the ESMWT director.

Four meetings of the regional representatives as a separate group were held, after which matters of interest to the regional representatives were discussed in meetings of the regional advisers, since it was important that all regional advisers be kept fully informed of developments in the relationships between ESMWT and WMC.

The regional representatives originally appointed, with the area which each represented, were:

Regional Representative	*Address*	*Area for Representation*	*WMC Region Number*
William C. White	Dean, College of Engineering Northeastern University Boston, Mass.	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.	1
Albert B. Newman	Dean, School of Technology City College of the College of the City of New York Mailing Address: 342 Madison Avenue New York, N. Y.	New York State.	2

Regional Representative	Address	Area for Representation	WMC. Region Number
A. R. Cullimore	President Newark College of Engineering Newark, N. J.	Delaware, New Jersey, and Pennsylvania.	3
S. S. Steinberg	Dean, College of Engineering University of Maryland College Park, Md.	District of Columbia, Maryland, North Carolina, Virginia, West Virginia.	4
C. E. MacQuigg	Dean, College of Engineering Ohio State University Columbus, Ohio	Kentucky, Michigan, and Ohio.	5
H. T. Heald	President Illinois Institute of Technology Chicago, Ill.	Illinois, Indiana, and Wisconsin.	6
Joseph Weil	Dean of Engineering University of Florida Gainesville, Fla.	Alabama, Florida, Georgia, Mississippi, South Carolina, and Tennessee.	7
H. O. Croft	Professor of Mechanical Engineering University of Iowa Iowa City, Iowa	Iowa, Minnesota, Nebraska, North Dakota, and South Dakota.	8
A. S. Langsdorf	Dean, School of Engineering Washington University St. Louis, Mo.	Arkansas, Kansas, Missouri, and Oklahoma	9
W. R. Woolrich	Dean, College of Engineering University of Texas Austin, Tex.	Louisiana, New Mexico, and Texas.	10
M. F. Coolbaugh	President Colorado School of Mines Golden, Colo.	Colorado, Idaho, Montana, Utah, and Wyoming.	11
S. B. Morris	Dean, School of Engineering Stanford University Stanford University, Calif.	Arizona, California, Nevada, Oregon, and Washington.	12

The only subsequent changes in regional representatives were the appointment of Prof. A. B. Domonoske, head of the Department of Mechanical Engineering at Stanford University, as regional representative in WMC Region 12 when Dean Morris resigned because of severing his connection with the University; and the later appointment of Prof. E. L. Grant, professor of the economics of engineering, to succeed Professor Domonoske when he resigned the position.

PARTICIPATING INSTITUTIONS

As outlined in chapter IV, participating institutions assumed certain responsibilities under the "Plan" which they submitted for each fiscal year of participation in the program. The chief of such responsibilities were for the determination of local training needs, the design of courses to meet these needs, the selection of trainees and of teachers, and the prompt submission to the Director of proposals, budgets, and reports which he

might from time to time require. The responsibility for discharging these duties was placed on the institutional representative, who acted as the representative of the president of his institution, and who conducted all negotiations with the director and with the regional adviser and regional representative for the region in which his institution was situated.

The purpose of this section is to discuss briefly certain principal functions and responsibilities of the institutional representative.

DISCOVERING TRAINING NEEDS

As previously stated, the determination of local training needs was always an important factor in the general program of administrative control over the ESMWT program. At the beginning of the program, it was also one of the most difficult duties of the institutional representative. At that time it was common experience with institutional representatives to find that industrial executives did not know the training and personnel needs of their industries and plants or could not foresee these training needs for more than a short period ahead of current operations. It was difficult, if not impossible, for industrial executives to anticipate exactly what their war contracts would be, what inroads Selective Service would make upon their personnel, the availability of qualified additional or replacement personnel, or the effects of many other factors which influenced their training needs. Furthermore, in spite of the wide publicity given the program, it was frequently discovered by institutional representatives that industrial executives did not know of the availability of ESMWT courses. This was also true in many instances of Federal agencies. While the policy-forming agencies in Washington were probably well acquainted with ESMWT, the carrying out of these policies was left to men in the field who of necessity must determine their own needs and solve their own problems, and who in many cases knew little or nothing about ESMWT.

The institutional representatives found it necessary to try to anticipate training needs in their localities, both for Federal agencies and for industries, by a careful and continuous study of local war contracts, the types of production indicated, the local labor market, the size of projects contemplated in the area, the general policies of Selective Service, and all other pertinent factors. It then usually became necessary for the institutional representative to make personal contact with industrial and Federal personnel executives and training directors in order to discuss with them training needs and to work out with them courses which would fill these needs.

Many courses were planned for groups of industries rather than single plants or industries. For these purposes the industries in some of the

smaller cities set up cooperative committees to work with the ESMWT representatives in the neighborhood. In other cases, chambers of commerce or State manufacturers associations set up committees representing the industries and Federal agencies involved in manpower and training problems. These and other methods were used to secure proper relations between the colleges and the industries they served. This broad cooperation was particularly serviceable in cases where changes in war contracts imposed changes in training courses. As the program developed, men in industry became better acquainted with training possibilities and came to the colleges with requests for training, which simplified the work of the institution.

DESIGNING COURSES TO MEET NEEDS

While the standard course outlines prepared in the Washington office were suggestions to participating institutions for courses which would meet needs foreseen on a national scale, some of these courses might fit local needs discovered by a particular institution, or none might be satisfactory. Even in cases where they were used, it was nearly always necessary to make some modifications in the standard course outlines to fit the particular problems of the industry or industries being served. In the great majority of cases these standard outlines served only as suggestions, and special courses more serviceable locally were designed by the institutional representatives in cooperation with representatives of the industries being served.

This designing of special courses imposed a heavy burden on the participating institutions. Some evidence of the size of this task is given in table III which gives for each participating institution the number of *different course titles* approved by the Director from those submitted by it during its participation in the program. In most cases this list does not give a fair indication of the number of special courses designed by an institution, since many of its courses were repeated time after time under the same course title, with restudy and revisions of the course content nearly every time the course was offered. The total number of special courses designed by the institutions in the ESMWT program is therefore much larger than is indicated by table III, and represents a tremendous amount of arduous and highly important work.

In designing special courses to meet direct needs, preconceived notions of course outlines from an academic point of view frequently differed radically from the needs of the company. It was generally found necessary to discard normal academic ideas of course planning and to design the courses directly to fill definite and specific needs, always bearing in mind that courses should be designed to meet immediate definite needs, rather than as parts of programs of general or technical education.

Table III.—Number of Different Course Titles Approved for Participating Institutions, 1940–45

Institution	Number of years' participation in program	Number of different course titles approved
1	2	3
ALABAMA		
Alabama Polytechnic Institute	5	168
University of Alabama	5	322
ARIZONA		
University of Arizona	5	16
ARKANSAS		
University of Arkansas	5	41
CALIFORNIA		
California Institute of Technology	5	943
Occidental College	1	4
San Jose State College	3	4
Stanford University	5	108
University of California	5	884
University of Redlands	3	12
University of Santa Clara	5	53
University of Southern California	5	464
COLORADO		
Colorado School of Mines	5	46
Colorado State College	4	34
Regis College	1	1
University of Colorado	5	210
University of Denver	5	72
CONNECTICUT		
University of Connecticut	5	189
Yale University	5	113
DELAWARE		
University of Delaware	5	48
FLORIDA		
University of Florida	5	96
GEORGIA		
Atlanta University	3	12
Georgia School of Technology	5	112
IDAHO		
University of Idaho	3	6
ILLINOIS		
Bradley Polytechnic Institute	5	88
Central YMCA College	4	46
DePaul University	4	76
Illinois Institute of Technology	5	391
Lake Forest College	1	8
Loyola University	1	7
Northwestern University	5	129
University of Chicago	3	31
University of Illinois	5	166
Wheaton College	4	15
INDIANA		
Butler University	4	12
Indiana University	4	65
Purdue University	5	293
Rose Polytechnic Institute	5	43
University of Notre Dame	5	70
IOWA		
Drake University	4	18
Iowa State College	5	26
St. Ambrose College	1	1
State University of Iowa	5	70
KANSAS		
Kansas State College	4	19
University of Kansas	5	166
KENTUCKY		
University of Kentucky	5	60
University of Louisville	5	55
LOUISIANA		
Centenary College of Louisiana	3	16
Dillard University	2	2
Louisiana Polytechnic Institute	5	33
Louisiana State University	5	33
Loyola University	4	33
Southwestern Louisiana Institute	4	3
Southern University and Agricultural and Mechanical College	3	5
Tulane University of Louisiana	5	60
MAINE		
Bates College	3	5
University of Maine	5	66
MARYLAND		
Johns Hopkins University	5	148
University of Baltimore	3	54
University of Maryland	5	133
MASSACHUSETTS		
American International College	3	10
Boston College	4	20
Boston University	4	38
Clark University	2	4
Harvard University	5	33
Lowell Textile Institute	3	16
Massachusetts Institute of Technology	5	85
Massachusetts State College	5	21
Northeastern University	5	135
Simmons College	3	12
Smith College	3	3
Tufts College	5	43
Wellesley College	2	3
Worcester Polytechnic Institute	5	30
MICHIGAN		
Detroit Institute of Technology	5	70
Lawrence Institute of Technology	5	38
Michigan College of Mining and Technology	5	14
Michigan State College	5	52
University of Detroit	5	116
University of Michigan	5	169
Wayne University	5	140
MINNESOTA		
St. Olaf College	2	7
University of Minnesota	5	170
MISSISSIPPI		
Mississippi State College	5	100
University of Mississippi	3	11
MISSOURI		
Lincoln University	2	9
Missouri School of Mines	5	16
St. Louis University	4	45
University of Missouri	3	22
Washington University	5	185
MONTANA		
Montana School of Mines	3	3
Montana State College	4	8
NEBRASKA		
University of Nebraska	5	64
NEVADA		
University of Nevada	3	0
NEW HAMPSHIRE		
Dartmouth College	4	42
University of New Hampshire	5	47
NEW JERSEY		
Newark College of Engineering	5	103
Princeton University	5	54
Rutgers University	5	207
Stevens Institute of Technology	5	45
University of Newark	4	42
NEW MEXICO		
New Mexico College of Agriculture and Mechanic Arts	2	4
University of New Mexico	5	35
NEW YORK		
Brooklyn College	2	2
Canisius College	2	4

Table III.—Number of Different Course Titles Approved for Participating Institutions, 1940–45—Continued

Institution	Number of years' participation in program	Number of different course titles approved
1	2	3
City College of College of the City of New York	5	135
Clarkson College of Technology	5	34
Columbia University	4	28
Cooper Union Institute of Technology	2	7
Cornell University	5	202
Defense Training Institute	4	3
Hofstra College	4	40
Hunter College	4	17
Long Island University	4	36
Manhattan College	5	141
New York University	5	188
Niagara University	3	43
Polytechnic Institute of Brooklyn	5	136
Pratt Institute	5	89
Rensselaer Polytechnic Institute	5	84
St. Bonaventure College	3	44
St. John's University	4	18
Syracuse University	5	104
Union College	5	57
University of Buffalo	4	93
University of Rochester	5	69
Vassar College	1	3
NORTH CAROLINA		
Agricultural and Technical College of North Carolina	4	15
Duke University	5	37
North Carolina College for Negroes	4	41
North Carolina State College	5	70
University of North Carolina	4	23
NORTH DAKOTA		
North Dakota Agricultural College	3	9
University of North Dakota	3	15
OHIO		
Antioch College	5	47
Case School of Applied Science	5	153
Fenn College	5	143
Heidelberg College	1	1
Miami University	4	42
Ohio Northern University	5	70
Ohio State University	5	144
Ohio University	5	68
University of Akron	5	61
University of Cincinnati	5	89
University of Dayton	5	77
University of Toledo	5	127
Western Reserve University	4	44
Wilberforce University	3	3
Youngstown College	3	7
OKLAHOMA		
Langston University	4	9
Oklahoma Agricultural and Mechanical College	5	37
Oklahoma City University	4	24
University of Oklahoma	5	142
University of Tulsa	5	61
OREGON		
Oregon State College	5	77
PENNSYLVANIA		
Bryn Mawr College	2	1
Bucknell University	4	17
Carnegie Institute of Technology	5	99
Drexel Institute of Technology	5	134
Franklin and Marshall College	4	27
Grove City College	4	10
Haverford College	4	10
Lafayette College	4	49
Lehigh University	4	25
Muhlenberg College	4	24
Pennsylvania Military College	2	1
Pennsylvania State College	5	218
St. Joseph's College	2	24
Swarthmore College	5	49
Temple University	4	108
University of Pennsylvania	5	239
University of Pittsburgh	5	233
Villanova College	5	85
Wilson College	1	1
RHODE ISLAND		
Brown University	5	81
Rhode Island State College	5	129
SOUTH CAROLINA		
The Citadel	5	29
Clemson Agricultural College	5	15
Furman University	2	4
Colored Normal, Industrial, Agricultural and Mechanical College	5	14
University of South Carolina	5	24
SOUTH DAKOTA		
South Dakota State College	3	8
TENNESSEE		
Fisk University	1	2
Tennessee Polytechnic Institute	1	3
University of Tennessee	5	123
Vanderbilt University	5	86
TEXAS		
Agricultural and Mechanical College of Texas	5	216
Baylor University	4	29
College of Mines and Metallurgy	5	14
East Texas State Teachers College	1	1
Hardin Simmons University	3	7
North Texas State Teachers College	3	11
Rice Institute	3	24
Southern Methodist University	5	143
Texas Christian University	4	23
Texas College of Arts and Industries	5	81
Texas Technological College	5	84
University of Houston	3	21
University of Texas	5	223
West Texas State Teachers College	3	8
UTAH		
Brigham Young University	4	11
University of Utah	4	68
Utah State Agricultural College	3	10
VERMONT		
Norwich University	5	27
University of Vermont	2	4
VIRGINIA		
College of William and Mary	1	6
Hampton Institute	3	24
University of Richmond	4	69
University of Virginia	5	171
Virginia Military Institute	5	11
Virginia Polytechnic Institute	5	116
Virginia State College for Negroes	4	25
Virginia Union University	3	9
WASHINGTON		
Gonzaga University	3	3
State College of Washington	5	13
University of Washington	5	109
WEST VIRGINIA		
West Virginia State College	4	12
West Virginia University	5	67

Table III.—Number of Different Course Titles Approved for Participating Institutions, 1940–45—Continued

Institution	Number of years' partici-pation in program	Number of different course titles approved	Institution	Number of years' partici-pation in program	Number of different course titles approved
1	2	3	1	2	3
WISCONSIN			DISTRICT OF COLUMBIA		
Marquette University	4	21	Catholic University of America	5	73
University of Wisconsin	5	188	George Washington University	5	139
WYOMING			Howard University	5	147
University of Wyoming	5	22	HAWAII		
ALASKA			University of Hawaii	1	6
University of Alaska	1	1	PUERTO RICO		
			University of Puerto Rico	3	16

RECRUITING, SELECTING, AND PLACING TRAINEES

After a course was designed to meet a specific need and had been approved by the director, the institution was faced with the responsibility of recruiting and selecting trainees for the course. Recruiting was done by means of newspaper and radio announcements, direct mail, display announcements, company publications, and programs exhibited on company bulletin boards. Selection of trainees from among those applying was generally accomplished by means of the examination of application blanks filled out by prospective trainees to show previous training and experience, by personal interviews, and in some cases by formal tests. Most institutional representatives were agreed that the personal interview was probably the most useful of these devices.

The placing of trainees usually presented no particular difficulty. The majority of the courses gave in-service training to people already employed, in which case no problem presented itself. As to preemployment trainees, the institutional representatives found that by keeping in touch with personnel officers and keeping them informed of the courses being conducted, little or no difficulty was encountered in placing these trainees. Studies made at various times during the program indicated that a high percentage of all trainees were employed in war industries following completion of their courses.

The numbers of trainees enrolled in the various participating institutions are set forth in table IV, which shows the authorized enrollment for each institution for each year of its participation in the program.

Table IV.—Total Enrollment for All Programs by State and Institution

Institution, by State	EDT 1940–41	ESMDT 1941–42	ESMWT-I 1942–43	ESMWT-II 1943–44	ESMWT-III 1944–45	All programs 1940–45
1	2	3	4	5	6	7
UNITED STATES TOTAL	130, [illegible]	[illegible]	[illegible], 134	[illegible]	387, [illegible]	1, 795, 716
ALABAMA	4, [illegible]	31, [illegible]	21, [illegible]	9, [illegible]	4, 615	61, [illegible]
Alabama Polytechnic Institute	3, 001	10, 675	11, [illegible]	4, 570	[illegible]	[illegible]
University of Alabama	1, [illegible]	10, [illegible]	[illegible]	4, [illegible]	2, [illegible]	[illegible]

Table IV.—Total Enrollment for All Programs, by State and Institution—Continued

Institution, by State	EDT 1940–41	ESMDT 1941–42	ESMWT-I 1942–43	ESMWT-II 1943–44	ESMWT-III 1944–45	All programs 1940–45
1	2	3	4	5	6	7
ARIZONA	15	147	240	205	109	717
University of Arizona	15	147	240	205	109	717
ARKANSAS	76	1,140	1,549	668	227	3,660
University of Arkansas	76	1,140	1,549	668	227	3,660
CALIFORNIA	6,680	41,424	73,760	75,092	48,776	247,732
California Institute of Technology	984	5,260	11,227	7,943	2,783	28,286
Occidental College	0	0	86	0	0	86
San Jose State College	0	0	23	196	101	319
Stanford University	105	3,607	6,906	5,467	3,809	19,894
University of California	4,055	24,574	43,855	46,376	31,961	150,621
University of Redlands	0	0	37	87	366	490
University of Santa Clara	131	643	906	576	746	3,004
University of Southern California	1,385	7,501	12,720	14,447	9,010	45,082
COLORADO	2,286	5,475	6,073	2,418	1,190	17,441
Colorado School of Mines	396	1,134	554	115	60	2,258
Colorado State College	87	266	380	46	0	779
Regis College	0	40	0	0	0	40
University of Colorado	1,157	2,546	3,855	1,518	585	9,661
University of Denver	646	1,499	1,525	730	336	4,643
CONNECTICUT	4,531	8,637	8,725	7,666	4,907	34,766
University of Connecticut	2,574	4,259	4,965	4,290	3,037	19,435
Yale University	1,957	4,378	3,760	3,386	1,870	15,331
DELAWARE	490	351	604	314	359	2,118
University of Delaware	490	351	604	314	359	2,118
FLORIDA	1,286	3,221	3,371	1,949	943	10,770
University of Florida	1,286	3,221	3,371	1,949	943	10,770
GEORGIA	247	1,506	2,448	1,872	1,720	7,793
Atlanta University	0	0	344	134	39	517
Georgia School of Technology	247	1,506	2,104	1,738	1,681	7,276
IDAHO	0	289	214	21	0	524
University of Idaho	0	289	214	21	0	524
ILLINOIS	5,455	25,593	52,396	31,552	15,494	133,590
Bradley Polytechnic Institute	217	719	868	1,082	910	3,831
Central YMCA College	0	100	1,161	2,146	1,285	4,701
DePaul University	0	787	6,094	3,135	1,781	11,800
Illinois Institute of Technology	4,906	11,953	21,102	12,982	6,449	57,392
Lake Forest College	0	0	0	60	0	60
Loyola University	0	0	0	123	0	123
Northwestern University	245	2,450	3,738	1,912	1,548	9,893
University of Chicago	0	2,480	2,537	607	0	5,624
University of Illinois	87	7,016	16,454	9,440	6,468	39,474
Wheaton College	0	79	221	53	53	406
INDIANA	4,541	31,252	31,358	18,378	9,172	94,703
Butler University	0	220	80	89	30	427
Indiana University	0	2,701	7,418	5,859	2,778	18,760
Purdue University	3,303	24,647	20,576	10,466	5,259	64,251
Rose Polytechnic Institute	595	1,344	803	152	115	3,010
University of Notre Dame	643	2,333	2,481	1,818	991	8,266
IOWA	1,222	4,314	3,610	1,712	1,084	11,942
Drake University	0	305	462	349	135	1,051
Iowa State College	411	1,702	1,006	321	172	3,672
St. Ambrose College	0	51	0	0	0	51
State University of Iowa	811	2,256	2,062	1,233	776	7,138

Table IV.—Total Enrollment for All Programs, by State and Institution—Continued

Institution, by State	EDT 1940–41	ESMDT 1941–42	ESMWT-I 1942–43	ESMWT-II 1943–44	ESMWT-III 1944–45	All programs 1940–45
1	2	3	4	5	6	7
KANSAS	3,327	9,886	15,379	7,394	3,957	39,943
Kansas State College	213	510	581	98	0	1,202
University of Kansas	3,114	9,376	14,798	7,296	3,957	38,741
KENTUCKY	838	2,442	2,347	1,503	668	7,798
University of Kentucky	339	1,713	1,491	931	391	4,865
University of Louisville	499	729	856	572	277	2,933
LOUISIANA	798	3,390	4,297	3,271	1,701	13,348
Centenary College of Louisiana	0	207	398	201	0	806
Dillard University	0	0	0	28	12	40
Louisiana Polytechnic Institute	67	230	538	439	483	2,022
Louisiana State University	165	523	191	580	314	1,773
Loyola University	0	187	679	412	145	1,423
Southern University and Agricultural and Mechanical College	0	0	91	126	27	244
Southwestern Louisiana Institute	81	263	30	0	16	310
Tulane University of Louisiana	503	901	2,095	1,515	704	5,718
MAINE	894	1,563	1,512	87	104	4,100
Bates College	0	75	79	0	0	154
University of Maine	894	1,488	1,433	87	104	3,906
MARYLAND	2,988	5,197	7,714	7,989	5,787	29,655
Johns Hopkins University	1,217	2,876	3,862	2,784	1,809	12,548
University of Baltimore	0	0	831	1,896	1,556	4,283
University of Maryland	1,771	2,321	3,021	3,289	2,422	12,824
MASSACHUSETTS	2,661	9,590	15,943	8,587	5,525	42,255
American International College	0	0	307	81	35	423
Boston College	0	393	978	369	86	1,826
Boston University	0	775	556	227	141	1,699
Clark University	0	20	98	0	0	118
Harvard University	102	1,418	5,218	1,037	325	8,100
Lowell Textile Institute	0	49	137	0	378	564
Massachusetts Institute of Technology	900	2,237	3,707	1,391	208	8,443
Massachusetts State College	44	402	294	218	46	1,004
Northeastern University	749	2,430	3,271	4,423	4,011	14,884
Simmons College	0	0	51	325	238	614
Smith College	0	78	34	0	0	112
Tufts College	674	989	592	40	24	2,319
Wellesley College	0	33	13	0	0	46
Worcester Polytechnic Institute	192	706	696	426	33	2,103
MICHIGAN	4,345	17,989	22,067	13,392	6,088	63,881
Detroit Institute of Technology	197	986	1,804	1,674	667	5,308
Lawrence Institute of Technology	590	2,798	4,763	2,179	383	10,708
Michigan College of Mining and Technology	77	36	807	41	168	1,129
Michigan State College	236	2,191	1,860	954	935	6,176
University of Detroit	279	2,262	2,940	1,873	1,148	8,502
University of Michigan	951	3,447	3,798	2,719	1,609	12,524
Wayne University	2,015	6,269	6,095	3,952	1,178	19,499
MINNESOTA	862	1,513	3,919	3,650	2,868	12,821
St. Olaf College	0	27	10	0	0	37
University of Minnesota	862	1,486	3,909	3,650	2,868	12,784
MISSISSIPPI	137	3,363	3,634	1,806	637	9,587
Mississippi State College	137	3,038	3,273	1,727	637	8,812
University of Mississippi	0	325	351	79	0	755

Table IV.—Total Enrollment for All Programs, by State and Institution—Continued

Institution, by State	EDT	ESMDT	ESMWT-I	ESMWT-II	ESMWT-III	All programs
	1940-41	1941-42	1942-43	1943-44	1944-45	1940-45
1	2	3	4	5	6	7
MISSOURI	1,488	6,773	8,867	6,853	2,521	26,502
Lincoln University	0	0	73	139	0	212
Missouri School of Mines	131	216	501	124	12	984
St. Louis University	0	1,355	1,973	1,185	196	4,709
University of Missouri	0	1,112	1,252	1,341	0	3,705
Washington University	1,357	4,090	5,068	4,064	2,313	16,892
MONTANA	15	284	315	127	223	963
Montana School of Mines	15	110	50	0	0	175
Montana State College	0	174	265	127	223	788
NEBRASKA	312	944	1,788	1,060	622	4,726
University of Nebraska	312	944	1,788	1,060	622	4,726
NEVADA	35	0	48	327	0	410
University of Nevada	35	0	48	327	0	410
NEW HAMPSHIRE	663	1,785	1,119	743	499	4,809
Dartmouth College	76	716	361	150	0	1,303
University of New Hampshire	587	1,069	758	593	499	3,506
NEW JERSEY	3,129	18,140	26,557	19,109	12,615	79,550
Newark College of Engineering	1,274	2,499	2,191	1,991	1,626	9,581
Princeton University	167	734	888	1,100	730	3,619
Rutgers University	852	13,246	19,990	13,731	8,477	56,296
Stevens Institute of Technology	836	1,137	948	937	938	4,796
University of Newark	0	524	1,540	1,350	844	4,258
NEW MEXICO	299	871	450	438	145	2,212
New Mexico College of Agriculture and Mechanic Arts	29	50	0	0	0	79
University of New Mexico	270	821	450	438	145	2,133
NEW YORK	9,120	34,902	54,084	35,902	20,627	154,635
Brooklyn College	0	123	131	0	0	254
Canisius College	0	61	354	0	0	415
City College of the College of the City of New York	750	3,256	5,058	2,330	1,234	12,628
Clarkson College of Technology	108	2,036	2,014	524	239	4,921
Columbia University	394	1,423	2,548	1,096	0	5,461
Cooper Union Institute of Technology	0	0	199	92	0	291
Cornell University	2,854	6,270	10,619	6,870	3,531	30,144
Defense Training Institute	416	741	882	76	0	2,115
Hofstra College	0	119	462	572	637	1,790
Hunter College	0	182	577	429	337	1,525
Long Island University	0	566	733	806	396	2,501
Manhattan College	613	2,343	4,461	2,743	1,722	11,882
New York University	1,453	5,108	4,115	4,071	2,743	18,380
Niagara University	0	0	1,740	796	413	2,949
Polytechnic Institute of Brooklyn	385	2,032	3,724	3,043	2,260	11,444
Pratt Institute	200	644	1,961	2,651	1,485	6,941
Rensselaer Polytechnic Institute	375	1,547	1,940	1,422	796	6,080
St. Bonaventure College	0	0	530	204	242	976
St. John's University	0	0	0	0	359	359
Syracuse University	394	2,184	3,510	1,843	1,018	8,909
Union College	604	2,689	2,028	996	731	7,048
University of Buffalo	0	2,507	4,016	2,005	1,644	10,772
University of Rochester	904	1,069	2,285	1,857	868	6,983
Vassar College	0	0	178	0	0	178

Table IV.—Total Enrollment for All Programs, by State and Institution—Continued

Institution, by State	EDT 1940-41	ESMDT 1941-42	ESMWT-I 1942-43	ESMWT-II 1943-44	ESMWT-III 1944-45	All programs 1940-45
1	2	3	4	5	6	7
NORTH CAROLINA	947	5,116	5,849	3,082	1,280	16,274
Agricultural and Technical College of North Carolina	27	113	428	186	0	749
Duke University	80	582	361	200	165	1,387
North Carolina College for Negroes	0	286	518	584	64	1,342
North Carolina State College	840	3,794	3,913	1,778	892	11,217
University of North Carolina	0	401	644	375	159	1,579
NORTH DAKOTA	212	583	692	0	0	1,487
North Dakota Agricultural College	53	343	115	0	0	511
University of North Dakota	159	240	577	0	0	976
OHIO	8,332	29,394	29,783	20,991	11,514	100,014
Antioch College	146	121	470	4,587	691	2,015
Case School of Applied Science	1,610	4,024	4,881	2,153	1,206	13,138
Fenn College	785	4,195	4,089	3,216	1,767	14,047
Heidelberg College	0	52	0	0	0	52
Miami University	0	655	1,148	983	698	3,484
Ohio Northern University	725	1,137	2,162	1,359	532	5,915
Ohio State University	1,049	4,186	3,808	2,410	1,361	12,804
Ohio University	668	1,467	1,419	810	300	4,667
University of Akron	600	4,344	2,880	3,142	1,109	11,678
University of Cincinnati	408	1,878	1,507	1,308	528	5,714
University of Dayton	298	422	336	982	1,845	3,883
University of Toledo	2,114	5,420	3,850	2,062	1,048	14,518
Western Reserve University	0	1,828	3,638	1,877	981	7,309
Wilberforce University	0	0	148	58	0	208
Youngstown College	0	50	103	74	0	227
OKLAHOMA	627	3,736	9,870	7,212	4,014	25,459
Langston University	0	42	344	325	66	777
Oklahoma Agricultural and Mechanical College	73	60	1,288	813	366	2,600
Oklahoma City University	0	816	648	543	349	2,356
University of Oklahoma	288	2,278	6,541	4,462	2,778	16,342
University of Tulsa	266	534	1,099	1,086	528	3,483
OREGON	60	1,227	2,039	1,451	703	5,880
Oregon State College	60	1,227	2,039	1,451	703	5,880
PENNSYLVANIA	34,017	55,412	74,905	39,537	22,615	226,576
Bryn Mawr College	0	0	65	30	0	95
Bucknell University	331	425	342	120	0	1,218
Carnegie Institute of Technology	3,072	4,119	3,616	1,655	555	13,017
Drexel Institute of Technology	3,704	4,463	4,201	3,036	1,408	16,881
Franklin and Marshall College	0	281	737	675	530	2,213
Grove City College	50	281	240	35	0	606
Haverford College	0	139	168	171	17	492
Lafayette College	300	769	420	126	0	1,615
Lehigh University	400	291	150	26	0	867
Muhlenberg College	0	17	409	331	175	1,012
Pennsylvania Military College	0	95	40	0	0	135
Pennsylvania State College	18,111	55,000	42,812	15,969	9,037	141,800
St. Joseph's College	0	0	0	815	579	1,394
Swarthmore College	804	2,000	2,757	421	104	6,755
Temple University	0	714	3,800	6,329	4,326	15,169
University of Pennsylvania	3,390	5,802	7,018	6,122	2,709	25,301
University of Pittsburgh	2,500	9,108	7,490	3,443	1,421	24,002
Villanova College	267	970	531	479	304	2,751
Wilson College	0	0	31	0	0	31
RHODE ISLAND	579	2,489	3,042	5,149	4,281	14,890
Brown University	399	2,105	1,081	784	409	3,[illegible]
Rhode Island State College	180	384	1,961	4,365	3,[illegible]	10,7[illegible]

Table IV.—Total Enrollment for All Programs, by State and Institution—Continued

Institution, by State	EDT	ESMDT	ESMWT-I	ESMWT-II	ESMWT-III	All programs
	1940-41	1941-42	1942-43	1943-44	1944-45	1940-45
1	2	3	4	5	6	7
SOUTH CAROLINA	881	2,785	3,363	1,554	839	9,422
The Citadel	361	1,209	857	524	232	3,183
Clemson Agricultural College	106	449	1,160	549	419	2,683
Furman University	0	0	96	51	28	177
Colored Normal, Industrial Agricultural, and Mechanical College	58	89	201	69	16	433
University of South Carolina	356	1,038	1,047	361	144	2,946
SOUTH DAKOTA	182	186	148	0	0	516
South Dakota State College	182	186	148	0	0	516
TENNESSEE	1,068	3,597	5,991	4,146	3,204	17,906
Fisk University	0	0	11	0	0	11
Tennessee Polytechnic Institute	25	0	0	0		25
University of Tennessee	531	2,889	4,790	3,593	2,807	14,610
Vanderbilt University	502	708	1,190	553	397	3,350
TEXAS	1,470	18,223	42,166	33,079	19,055	113,993
Agricultural and Mechanical College of Texas	432	7,348	17,570	11,306	8,036	44,232
Baylor University	0	304	313	296	106	1,017
College of Mines and Metallurgy	30	47	206	87	51	530
East Texas State Teachers College	0	0	24	0	0	24
Hardin Simmons University	0	148	110	0	0	258
North Texas State Teachers College	0	0	306	246	74	626
Rice Institute	0	300	569	124	0	1,093
Southern Methodist University	486	4,205	8,445	8,292	2,540	24,081
Texas Christian University	0	336	500	521	644	2,001
Texas College of Arts and Industries	53	205	849	1,188	731	3,026
Texas Technological College	28	712	1,755	636	357	3,488
University of Houston	0	0	448	288	197	933
University of Texas	392	4,468	10,924	9,878	6,197	31,859
West Texas State Teachers College	0	0	54	166	73	293
UTAH	501	1,711	2,039	809	706	5,886
Brigham Young University	0	91	222	79	43	435
University of Utah	458	1,533	1,702	730	753	5,176
Utah State Agricultural College	43	87	115	0	0	345
VERMONT	165	377	224	303	162	1,231
Norwich University	140	357	224	189	162	1,072
University of Vermont	25	20	0	114	0	159
VIRGINIA	1,904	4,383	6,914	4,151	2,119	19,470
College of William and Mary	0	0	31	0	0	31
Hampton Institute	0	413	1,010	846	0	2,269
University of Richmond	0	343	1,467	899	477	2,876
University of Virginia	621	1,411	2,032	1,457	1,047	6,568
Virginia Military Institute	103	166	93	54	45	461
Virginia Polytechnic Institute	1,180	1,890	1,878	936	499	6,313
Virginia State College for Negroes	0	217	413	286	61	979
Virginia Union University	0	0	20	31	0	51
WASHINGTON	900	2,943	3,980	2,903	1,726	12,451
Gonzaga University	21	69	21	0	0	111
State College of Washington	62	86	326	89	40	603
University of Washington	817	2,788	3,633	2,813	1,686	11,737

Table IV.—Total Enrollment for All Programs, by State and Institution—Continued

Institution, by State	EDT	ESMDT	ESMWT-I	ESMWT-II	ESMWT-III	All programs
	1940–41	1941–42	1942–43	1943–44	1944–45	1940–45
1	2	3	4	5	6	7
WEST VIRGINIA	2,700	4,012	4,836	1,549	550	13,644
West Virginia State College	0	12	262	178	82	514
West Virginia University	2,700	4,007	4,584	1,371	468	13,130
WISCONSIN	237	5,097	16,900	8,043	4,944	35,220
Marquette University	102	753	760	364	0	1,979
University of Wisconsin	135	4,344	16,200	7,678	4,944	33,301
WYOMING	102	410	612	315	115	1,554
University of Wyoming	102	410	612	315	115	1,554
ALASKA	0	0	0	0	31	31
University of Alaska	0	0	0	0	31	31
DISTRICT OF COLUMBIA	2,234	5,863	5,229	4,554	3,234	21,103
Catholic University of America	145	1,006	1,338	1,201	1,016	4,703
George Washington University	1,801	3,852	3,363	2,948	2,036	14,000
Howard University	575	705	533	405	182	2,400
HAWAII	0	0	0	0	178	178
University of Hawaii	0	0	0	0	178	178
PUERTO RICO	108	103	135	0	0	346
University of Puerto Rico	108	103	135	0	0	346

SELECTING, TRAINING, AND SUPERVISING TEACHERS

Selection of instructors for the ESMWT courses was an element of great importance and was usually successfully done, although many difficulties were encountered. This was an emergency program in which urgent training needs must be met promptly to enable rapidly expanding war industries to operate effectively. It was necessary to design the courses, recruit students, select the teachers, choose the texts and other instructional materials, and get the courses started in the briefest possible period. At the same time, the institution was responsible for making certain that every course in its ESMWT program was conducted at the college level and in such a manner that the institution need have no more hesitancy in sponsoring the course than in sponsoring its regular academic courses.

Because of reduction in college and university staffs and because of increased loads on the remaining staff members due to various wartime activities, regular members of the faculty became less and less available for conducting ESMWT courses. Furthermore, it sometimes was found that a college teacher who had a masterly knowledge of his subject, but who had acquired little or no intimate relations with industry, proved to be inadequate as an instructor of adult employees working in industry.

For these reasons, and also because of the many locations off the campus in which some institutions conducted courses, it was found necessary as

the program progressed, to recruit men employed in industries as teachers of ESMWT courses.

This created the problem of discovering and using as teachers persons who were not primarily teachers, in place of college professors who were trained and experienced teachers. Many men could be found in industry highly competent professionally and technically in the subject matter to be covered by ESMWT courses. But in many instances such a man lacked experience in the art of teaching and conceived of his duties in the course as solely a matter of expressing his own views rather than of bringing the minds of men of lesser experience, and perhaps of lesser ability, to a mental level equal to his own in the particular subject concerned. It was because of this condition that the requirement was made throughout the program that every ESMWT course should be under the educational supervision of a regular member of the college faculty chosen from the department responsible for academic instruction in the subject covered by the course.

That the institutions recognized the problems involved was shown in the responses from them to a request of the National Advisory Committee in the spring of 1942 for outlines of methods employed in the institutions for supervising the teaching of courses being taught by men from industry. Practically without exception the institutions which were employing such men as teachers were taking definite and specific steps to insure that such teachers, unless they had previous college teaching experience, were given quite specific instructions by the persons in educational charge of their courses. The institutions were also maintaining programs of supervision over these teachers, to aid them in making their instruction as effective as possible.

A digest of the reports from the institutions was prepared and sent to all institutional representatives, listing the methods of supervising ESMDT teachers most frequently mentioned in the reports. Some of the methods were: Teacher-training courses, frequent attendance at classes by supervisors, preparation of course outlines by supervisors, requirement that teachers prepare and submit complete syllabi of courses or in some cases detailed outlines of each lecture, detailed printed or mimeographed instructions to teachers or students or both relating to teaching methods and mechanical details, conferences of teachers in the same subject, qualifying examinations and placement tests for sectioning classes according to ability of students, and frequent visits to industrial plants by both teachers and supervisors.

Some institutions prepared manuals for the training of teachers of ESMWT courses. One such manual, prepared at the Pennsylvania State College, was sent to all institutional representatives in December 1942, with a letter stating that "Other institutions such as Yale University, Temple University, and the University of Santa Clara have also issued

such manuals, which may be of use to you." This letter also called attention to the instructor-training courses conducted by the Training-Within-Industries branch of the War Production Board and to Army Training Film 7-295 dealing with the essentials of good teaching.

The experience in the program with teachers selected from industry was generally satisfactory. It was found that with proper precautions competent men could be selected with good educational background, technical competence, ability to command attention and win respect and confidence, and, above all, with an interest in the job and a willingness to try and to accept advice. The necessary modicum of instruction in good teaching methods could be conveyed to such men in a short time, and such persons in general did an excellent job of conducting ESMWT courses. In many instances they probably did better work than would have been done by regular members of the college staff, because they had a thorough grasp of the specific requirements which the course was designed to meet, and of the jobs which were to be filled by trainees, and also because their industrial experience in many cases gave them a more practical approach to their class work than might have been the case with a teacher whose background was more theoretical.

PROPOSALS AND REPORTS TO THE WASHINGTON OFFICE

It was the duty of the institutional representative to make sure that all proposals for courses, for administrative budgets, for working funds, and for regional coordination were properly prepared and promptly submitted to the Washington office, that all expenditures made from ESMWT funds were authorized by the Director, and that enrollment and financial reports were promptly submitted as required, including the final report at the end of each fiscal year. It was also his duty to see that copies of the proper forms were sent to the regional advisers and to the regional representatives.

INSTITUTIONAL RECORDS

A further responsibility of the institutional representative was to make certain that adequate records were maintained by the institution of each course conducted and of each trainee enrolled therein, records which, in general, would parallel the records kept by the institution for courses and students in its regular college program. With few exceptions, ESMWT courses were not described in regular college catalogs, which made it particularly important that the institution maintain descriptions of the courses conducted in its ESMWT program, so that it would be able after the close of the program to furnish former trainees accurate statements of work completed at the institution in ESMWT courses.

Many institutions adopted the practice of keeping trainee records on the same record forms used for their regular students. Others used only the

forms provided by the ESMWT office, while some institutions used both. No definite requirements in this respect were ever set up by the Washington office, but institutions were repeatedly advised that they had the same responsibility for ESMWT courses that they had for their regular courses, and were urged to keep complete and accurate records of courses and trainees.

INSTITUTIONAL EXPENDITURES

In a program which engaged the services of so many separate institutions, each with its own peculiar local conditions, and which served so many different kinds and types of industries with a wide variety of types of courses, any comparison of costs as between institutions or between types of instruction needs to be made with great care. Because of the wide variation in the character and amount of war industry in the different States, and of the different types of programs conducted by different institutions, even within a single State, there was a wide range in the expenditures made by individual institutions, and by the groups of institutions situated in different States.

It was emphasized throughout the 5 years of the program that participating institutions were to be reimbursed by the Federal Government for actual costs incurred by the conduct of ESMWT courses over and above costs which the institution would have had if it had not conducted these courses. It was the intention that participating institutions should be reimbursed for actual "out-of-pocket" costs and that they should neither make a profit nor suffer a loss because of conducting these courses. However, many of the institutions did not charge to the cost of courses all of the costs that they incurred, preferring to contribute part of these costs as an institutional contribution to the war effort. For example, many institutions absorbed part or all of the administrative costs incurred in conducting the program and charged only for actual salaries of instructors and for purchase of equipment and supplies.

The total sums expended by each of the participating institutions during the 5 years of the program are shown in table V, which also includes the total amount expended in each State and in the Nation for each year. The table is based upon the records of the Washington office as of January 31, 1946, and all items are rounded off to the nearest whole dollar. The national totals do not check the sum of the State totals because of the cumulative error caused by rounding off institutional totals.

As should be expected, there is a wide range in the expenditures made by individual institutions and by the groups of institutions situated in different States. This table is included as a matter of record only, and no interstate or interinstitutional comparisons are intended or implied, since any such comparisons would have little or no significance unless accom-

panied by detailed information as to kind of courses and the local conditions in the States or institutions being compared.

Table V.—Total Expenditures* for All Programs, by State and Institution

Institution, by State	EDT	ESMDT	ESMWT-I	ESMWT-II	ESMWT-III	All programs
	1940–41	1941–42	1942–43	1943–44	1944–45	1940–45
1	2	3	4	5	6	7
UNITED STATES TOTAL[1]	6,135,963	14,942,054	19,871,484	12,139,461	6,978,078	59,967,040
ALABAMA	117,255	508,633	672,748	378,819	185,957	1,963,412
Alabama Polytechnic Institute	73,057	276,635	376,645	187,492	102,102	1,017,931
University of Alabama	44,198	231,998	294,103	188,327	83,855	935,481
ARIZONA	2,137	2,656	4,973	3,072	1,839	14,669
University of Arizona	2,137	2,656	4,973	3,073	1,839	14,669
ARKANSAS	3,163	26,096	44,026	16,628	6,245	96,157
University of Arkansas	3,163	26,096	44,026	16,628	6,245	96,157
CALIFORNIA	290,507	1,290,844	2,399,840	2,018,023	1,202,704	7,141,918
California Institute of Technology	91,240	201,845	298,306	306,840	123,787	1,122,018
Occidental College	0	0	3,891	0	0	3,891
San Jose State College	0	0	2,196	5,506	4,554	12,256
Stanford University	3,576	89,554	195,004	123,156	101,418	513,018
University of California	87,111	567,692	1,249,538	1,029,230	648,083	3,601,654
University of Redlands	0	0	614	3,576	7,819	12,009
University of Santa Clara	8,301	21,050	26,782	19,162	16,071	93,366
University of Southern California	98,979	230,693	521,509	530,493	300,972	1,783,646
COLORADO	108,698	195,563	200,009	90,160	39,642	637,052
Colorado School of Mines	26,076	56,903	20,382	12,794	11,192	127,347
Colorado State College	6,259	8,791	10,952	1,845	0	27,847
Regis College	0	267	0	0	0	267
University of Colorado	69,702	90,802	110,479	30,923	18,330	320,236
University of Denver	26,631	41,800	58,195	44,598	10,130	181,345
CONNECTICUT	137,753	272,503	247,853	216,245	132,417	1,006,771
University of Connecticut	89,804	161,651	149,987	130,057	79,910	611,709
Yale University	47,949	110,822	98,166	85,558	53,507	396,002
DELAWARE	18,485	14,695	18,923	11,558	9,037	72,598
University of Delaware	18,485	14,695	18,923	11,558	9,037	72,598
FLORIDA	85,340	119,894	126,257	58,302	33,974	425,777
University of Florida	85,340	119,894	126,257	58,302	33,974	425,777

* All expenditures indicated to nearest whole dollar.

[1] United States totals do not check sum of State totals, due to cumulative error caused by rounding off institutional totals.

Table V.—Total Expenditures for All Programs, by State and Institution—Continued

Institution, by State	EDT 1940–41	ESMDT 1941–42	ESMWT-I 1942–43	ESMWT-II 1943–44	ESMWT-III 1944–45	All programs 1940–45
1	2	3	4	5	6	7
GEORGIA	8,720	52,080	82,048	43,137	26,230	212,215
Atlanta University	0	0	10,371	6,062	1,414	17,847
Georgia School of Technology	8,720	52,080	71,677	37,075	24,816	194,368
IDAHO	0	3,939	5,900	201	137	10,177
University of Idaho	0	3,939	5,900	201	137	10,177
ILLINOIS	253,657	860,284	1,754,878	889,713	582,487	4,362,608
Bradley Polytechnic Institute	5,033	17,830	19,025	19,702	20,131	81,681
Central YMCA College	0	3,498	20,007	44,547	28,088	96,140
De Paul University	0	24,227	152,280	84,151	46,016	306,714
Illinois Institute of Technology	240,670	408,351	914,874	838,878	282,570	2,412,343
Lake Forest College	0	0	0	1,183	0	1,183
Loyola University	0	0	0	2,087	0	2,087
Northwestern University	4,104	69,880	129,440	47,680	43,808	294,857
University of Chicago	0	110,836	147,888	16,007	0	309,730
University of Illinois	3,080	185,747	382,808	211,230	165,547	918,873
Wheaton College	0	808	7,887	1,381	1,880	11,936
INDIANA	93,032	683,470	708,465	544,887	281,673	2,311,887
Butler University	0	3,838	2,462	1,703	230	8,038
Indiana University	0	20,039	117,785	124,840	67,830	330,490
Purdue University	65,442	608,437	514,880	361,084	184,491	1,651,884
Rose Polytechnic Institute	16,150	25,900	26,507	6,097	5,081	79,734
University of Notre Dame	11,431	28,770	43,831	60,031	24,108	167,048
IOWA	57,687	116,430	88,219	36,559	27,078	330,098
Drake University	0	2,788	7,232	3,050	2,770	14,916
Iowa State College	26,770	36,167	16,859	2,879	1,847	84,082
St. Ambrose College	0	1,488	0	0	0	1,488
State University of Iowa	31,917	75,063	67,061	31,110	23,447	227,598
KANSAS	90,076	138,428	238,870	168,087	67,788	628,130
Kansas State College	22,296	36,066	35,455	31,049	287	125,139
University of Kansas	67,770	102,856	203,415	137,018	67,508	694,878
KENTUCKY	34,970	108,416	81,383	45,247	19,398	290,524
University of Kentucky	14,852	78,061	52,268	29,373	12,447	187,888
University of Louisville	20,118	30,367	29,320	16,874	6,950	102,636
LOUISIANA	36,568	67,019	165,636	126,690	67,085	461,188
Centenary College of Louisiana	0	4,606	12,730	7,944	0	25,378
Dillard University	0	0	0	1,898	808	2,706
Louisiana Polytechnic Institute	4,012	9,687	46,588	26,693	24,341	112,178
Louisiana State University	5,458	13,010	4,081	10,000	6,448	42,083
Loyola University	0	4,088	22,768	17,837	6,082	50,355
Southern University and Agricultural and Mechanical College	0	0	6,344	5,032	1,000	12,376
Southwestern Louisiana Institute	2,981	4,329	1,004	0	208	8,472
Tulane University of Louisiana	21,104	30,417	67,701	88,493	27,144	234,858
MAINE	16,430	53,680	81,045	2,435	4,580	158,110
Bates College	0	3,208	4,037	0	0	7,963
University of Maine	16,430	50,384	76,958	2,435	4,580	150,168
MARYLAND	103,360	171,942	281,290	308,815	182,344	962,680
Johns Hopkins University	49,888	87,797	141,328	85,746	80,210	414,979
University of Baltimore	0	0	19,480	28,593	25,687	73,710
University of Maryland	53,872	84,145	120,471	144,476	76,407	494,481

Table V.—Total Expenditures for All Programs, by State and Institution—Continued

Institution, by State	EDT	ESMDT	ESMWT-I	ESMWT-II	ESMWT-III	All programs
	1940–41	1941–42	1942–43	1943–44	1944–45	1940–45
1	2	3	4	5	6	7
MASSACHUSETTS	175, 430	585, 111	948, 294	268, 319	195, 980	2, 173, 134
American International College	0	0	10, 456	4, 733	2, 491	17, 680
Boston College	0	13, 344	30, 981	14, 769	4, 799	63, 893
Boston University	0	17, 975	12, 483	2, 145	1, 559	34, 162
Clark University	0	562	4, 248	0	0	4, 810
Harvard University	7, 882	188, 797	388, 749	93, 017	49, 518	728, 963
Lowell Textile Institute	0	3, 806	8, 030	....	13, 644	25, 540
Massachusetts Institute of Technology	94, 980	211, 300	313, 011	14, 794	2, 315	636, 400
Massachusetts State College	638	7, 541	6, 250	3, 344	1, 303	19, 086
Northeastern University	26, 821	63, 126	114, 655	120, 321	115, 054	437, 976
Simmons College	0	0	3, 159	7, 301	4, 325	14, 785
Smith College	0	2, 666	1, 182	0	0	3, 848
Tufts College	39, 050	53, 069	22, 208	1, 536	352	116, 210
Wellesley College	0	1, 273	823	0	0	2, 096
Worcester Polytechnic Institute	7, 380	24, 511	23, 056	13, 390	670	68, 006
MICHIGAN	116, 158	405, 198	591, 836	386, 926	172, 283	1, 672, 384
Detroit Institute of Technology	5, 828	22, 433	42, 851	48, 812	21, 976	141, 894
Lawrence Institute of Technology	13, 469	46, 553	75, 516	66, 687	14, 866	216, 094
Michigan College of Mining and Technology	4, 896	1, 343	30, 690	3, 539	9, 804	50, 160
Michigan State College	8, 571	54, 347	52, 115	33, 394	29, 974	178, 339
University of Detroit	16, 601	35, 036	55, 072	48, 697	31, 018	187, 316
University of Michigan	22, 646	123, 426	199, 182	85, 310	29, 506	460, 083
Wayne University	45, 160	121, 263	136, 411	100, 586	34, 110	438, 498
MINNESOTA	107, 918	146, 947	182, 412	136, 893	96, 942	668, 611
St. Olaf College	0	1, 844	760	0	0	2, 604
University of Minnesota	107, 918	144, 103	181, 652	136, 893	96, 942	666, 707
MISSISSIPPI	16, 605	105, 404	90, 514	61, 834	23, 806	308, 251
Mississippi State College	16, 605	96, 902	85, 446	58, 797	23, 806	283, 044
University of Mississippi	0	8, 502	5, 068	3, 037	0	16, 607
MISSOURI	76, 188	159, 041	267, 366	161, 204	67, 657	731, 656
Lincoln University	0	0	1, 878	4, 964	0	6, 842
Missouri School of Mines and Metallurgy	14, 581	19, 721	45, 806	7, 037	341	88, 386
St. Louis University	0	24, 549	33, 342	26, 475	5, 696	90, 061
University of Missouri	0	24, 710	86, 700	62, 175	0	173, 586
Washington University	61, 607	90, 061	110, 680	60, 663	61, 620	384, 631
MONTANA	2, 013	15, 470	28, 472	14, 115	12, 386	72, 356
Montana School of Mines	2, 013	1, 372	1, 858	0	0	5, 243
Montana State College	0	14, 098	26, 614	14, 115	12, 386	67, 113
NEBRASKA	30, 096	70, 609	66, 787	38, 051	26, 005	232, 548
University of Nebraska	30, 096	70, 609	66, 787	38, 051	26, 005	232, 548
NEVADA	813	0	2, 176	3, 233	0	6, 222
University of Nevada	813	0	2, 176	3, 233	0	6, 222
NEW HAMPSHIRE	31, 396	70, 304	34, 955	20, 748	12, 093	169, 496
Dartmouth College	4, 715	23, 089	13, 851	4, 274	0	45, 919
University of New Hampshire	26, 681	47, 165	21, 104	16, 474	12, 093	123, 507
NEW JERSEY	208, 690	639, 515	555, 954	414, 070	374, 789	2, 061, 397
Newark College of Engineering	73, 469	35, 044	110, 262	50, 971	70, 967	432, 688
Princeton University	18, 375	33, 095	30, 128	31, 089	23, 044	130, 635
Rutgers University	60, 696	468, 115	365, 325	337, 861	333, 312	1, 676, 279
Stevens Institute of Technology	57, 450	93, 676	64, 773	13, 462	33, 646	333, 036
University of Newark	0	10, 685	32, 461	30, 696	24, 790	96, 663

Table V.—Total Expenditures for All Programs, by State and Institution—Continued

Institution, by State	EDT 1940–41	ESMDT 1941–42	ESMWT-I 1942–43	ESMWT-II 1943–44	ESMWT-III 1944–45	All programs 1940–45
1	2	3	4	5	6	7
NEW MEXICO	28,840	45,013	29,451	18,189	7,484	128,917
New Mexico College of Agriculture and Mechanic Arts	356	1,809	38	0	0	2,[illegible]
University of New Mexico	28,484	43,204	29,413	18,189	7,484	121,714
NEW YORK	477,290	1,434,187	2,089,905	1,055,350	659,008	5,705,747
Brooklyn College	0	7,277	9,380	0	0	16,656
Canisius College	0	2,326	14,690	0	0	17,016
City College of the College of the City of New York	45,690	113,469	184,021	84,420	60,285	487,884
Clarkson College of Technology	3,943	82,344	103,716	25,949	14,620	227,077
Columbia University	41,438	82,167	108,022	28,074	0	260,[illegible]
Cooper Union Institute	0	0	9,417	6,886	0	16,303
Cornell University	73,353	262,446	416,021	179,476	100,779	1,032,076
Defense Training Institute	97,983	170,073	147,840	7,019	0	422,894
Hofstra College	0	4,276	11,334	12,[illegible]	12,633	41,134
Hunter College	0	7,245	19,686	11,189	5,045	46,118
Long Island University	0	28,[illegible]	40,570	43,189	26,975	187,[illegible]
Manhattan College	35,377	117,[illegible]	154,556	103,[illegible]	49,[illegible]	477,[illegible]
New York University	57,494	147,765	169,262	98,051	65,[illegible]	[illegible]
Niagara University	0	0	40,[illegible]	28,[illegible]	16,728	84,[illegible]
Polytechnic Institute of Brooklyn	28,606	88,[illegible]	69,[illegible]	72,311	46,240	233,[illegible]
Pratt Institute	7,178	14,907	48,[illegible]	88,[illegible]	48,260	221,[illegible]
Rensselaer Polytechnic Institute	31,163	86,875	77,208	41,288	30,777	267,309
St. Bonaventure College	0	0	28,120	12,[illegible]	17,407	54,019
St. John's University	0	0	0	0	11,221	11,281
Syracuse University	5,440	70,490	154,156	80,794	34,053	344,944
Union College	35,322	89,432	40,423	36,[illegible]	25,055	206,547
University of Buffalo	0	57,580	121,141	69,300	26,[illegible]	283,140
University of Rochester	19,184	30,217	60,978	47,349	26,110	183,518
Vassar College	0	0	6,061	0	0	6,061
NORTH CAROLINA	127,603	298,129	308,048	128,167	57,340	895,199
Agricultural and Technological College of North Carolina	5,609	5,099	24,999	11,425	0	46,944
Duke University	6,240	28,109	16,128	6,485	5,479	62,370
North Carolina College for Negroes	0	12,899	29,979	27,419	2,999	72,799
North Carolina State College	117,744	224,287	215,[illegible]	70,221	[illegible]	698,321
University of North Carolina	0	14,832	17,340	10,719	2,307	44,759
NORTH DAKOTA	26,742	38,180	28,308	0	0	104,189
North Dakota Agricultural College	2,598	12,982	4,198	0	0	20,728
University of North Dakota	24,144	25,208	24,107	0	0	83,4[illegible]
OHIO	322,[illegible]	880,171	[illegible]	4[illegible]	2[illegible],204	2,7[illegible]
Antioch College	1,[illegible]	2,022	5,280	3,094	16,[illegible]	28,[illegible]
Case School of Applied Science	108,301	204,[illegible]	175,071	61,[illegible]	25,067	597,449
Fenn College	42,[illegible]	144,[illegible]	147,348	161,[illegible]	68,163	[illegible]
Heidelberg College	0	7,878	175	0	0	8,169
Miami University	0	10,416	18,221	14,004	11,324	45,073
Ohio Northern University	28,051	38,[illegible]	84,404	29,[illegible]	16,127	1[illegible]
Ohio State University	45,791	104,[illegible]	108,[illegible]	43,[illegible]	24,7[illegible]	237,7[illegible]
Ohio University	28,207	40,[illegible]	46,[illegible]	29,[illegible]	11,7[illegible]	1[illegible]
University of Akron	8,451	28,045	52,[illegible]	41,[illegible]	22,767	1[illegible]
University of Cincinnati	6,909	80,[illegible]	49,[illegible]	22,078	11,409	14[illegible]
University of Dayton	4,437	[illegible]	5,215	18,[illegible]	[illegible]	[illegible]
University of Toledo	50,073	[illegible]	110,457	62,[illegible]	[illegible]	41[illegible]
Western Reserve University	0	[illegible]	60,[illegible]	31,764	8,4[illegible]	140,[illegible]
Wilberforce University	0	0	4,[illegible]	2,[illegible]	0	6,078
Youngstown College	0	2,[illegible]	4,[illegible]	2,760	0	6,[illegible]

Table V.—Total Expenditures for All Programs, by State and Institution—Continued

Institution, by State	EDT 1940–41	ESMDT 1941–42	ESMWT-I 1942–43	ESMWT-II 1943–44	ESMWT-III 1944–45	All programs 1940–45
1	2	3	4	5	6	7
OKLAHOMA	20,046	80,726	286,804	265,665	123,874	777,890
Langston University	27	1,227	8,468	14,306	3,880	27,908
Oklahoma Agricultural and Mechanical College	4,464	8,691	66,710	66,680	16,800	158,371
Oklahoma City University	0	16,411	22,603	29,892	14,590	84,486
University of Oklahoma	8,416	55,234	190,995	185,114	77,259	467,088
University of Tulsa	7,127	10,383	16,574	19,466	10,125	63,673
OREGON	1,151	21,087	22,988	26,186	12,936	93,168
Oregon State College	1,151	21,087	22,988	26,186	12,936	93,168
PENNSYLVANIA	2,347,687	2,676,881	3,094,477	1,638,593	789,342	11,336,680
Bryn Mawr College	0	0	9,830	3,083	0	12,833
Bucknell University	20,643	13,880	10,633	3,971	0	60,116
Carnegie Institute of Technology	168,674	186,308	181,442	58,300	28,022	601,946
Drexel Institute of Technology	164,900	175,065	235,978	132,580	66,663	769,478
Franklin and Marshall College	0	11,332	23,494	26,117	18,544	81,507
Grove City College	3,480	6,380	9,076	1,048	0	23,987
Haverford College	0	7,000	7,867	7,238	1,114	23,218
Lafayette College	19,681	30,330	16,080	4,616	0	73,370
Lehigh University	26,615	16,688	18,841	1,425	0	66,889
Muhlenberg College	0	442	23,100	16,430	11,027	47,000
Pennsylvania Military College	0	4,730	1,437	0	0	6,168
Pennsylvania State College	1,880,075	2,197,445	1,694,318	662,208	308,004	6,103,048
St. Joseph's College	0	0	0	18,116	23,664	41,780
Swarthmore College	37,087	78,875	78,940	10,243	3,730	208,839
Temple University	0	63,772	260,549	216,680	152,094	693,095
University of Pennsylvania	203,510	208,900	193,145	148,808	[illegible]	666,703
University of Pittsburgh	290,030	480,330	502,020	170,373	[illegible]	1,507,000
Villanova College	16,046	35,851	30,664	13,947	11,[illegible]	142,328
Wilson College	0	0	677	0	[illegible]	677
RHODE ISLAND	25,081	51,683	95,478	150,684	124,328	448,020
Brown University	22,017	47,080	54,408	38,020	21,095	184,240
Rhode Island State College	3,074	7,080	41,070	112,664	103,330	263,580
SOUTH CAROLINA	41,804	82,870	110,430	45,488	21,354	303,080
The Citadel	15,178	33,726	33,223	14,086	7,300	104,340
Clemson Agricultural College	6,026	13,907	33,281	16,314	6,881	76,088
Colored Normal, State Industrial, Agricultural and Mechanical College	1,307	4,079	3,700	3,680	730	16,264
Furman University	0	0	1,790	1,087	701	3,578
University of South Carolina	18,227	30,135	38,377	10,180	3,746	96,680
SOUTH DAKOTA	7,800	6,691	7,700	220	200	22,704
South Dakota State College	7,800	6,691	7,700	220	200	22,704
TENNESSEE	51,004	57,362	162,800	107,800	68,415	478,960
Fisk University	0	0	800	0	0	800
Tennessee Polytechnic Institute	1,204	80	0	0	0	1,380
University of Tennessee	3,681	43,081	111,400	84,000	43,001	303,000
Vanderbilt University	46,210	32,430	50,707	23,190	25,514	174,000
TEXAS	180,808	697,670	1,360,735	1,078,134	603,316	3,933,754
Agricultural and Mechanical College of Texas	87,003	383,813	498,716	303,120	210,416	1,389,678
Baylor University	0	3,080	3,008	3,040	2,165	22,018
East Texas State Teachers College	0	0	800	0	0	800
Hardin-Simmons University	0	4,658	3,921	0	0	8,387
North Texas State Teachers College	0	0	11,128	9,226	2,790	23,139
Rice Institute	0	9,080	24,212	7,370	0	41,088
Southern Methodist University	38,031	138,401	300,503	174,087	63,745	693,900
Texas Christian University	0	3,163	20,128	22,040	20,384	71,180

Table V.—Total Expenditures for All Programs, by State and Institution—Continued

Institution, by State	EDT 1940–41	ESMDT 1941–42	ESMWT-I 1942–43	ESMWT-II 1943–44	ESMWT-III 1944–45	All programs 1940–45
1	2	3	4	5	6	7
Texas College of Arts and Industry	7,808	6,444	22,044	48,730	40,530	125,578
Texas College of Mines and Metallurgy	4,156	1,198	10,878	3,987	2,083	22,122
Texas Technological College	5,228	33,518	113,890	23,157	10,855	185,348
University of Houston	0	0	12,513	7,092	6,951	26,556
University of Texas	49,806	199,547	413,167	400,008	248,347	1,202,[illegible]
West Texas State Teachers College	0	0	2,948	2,708	1,880	6,903
UTAH	39,518	62,582	61,841	21,089	18,469	203,419
Brigham Young University	0	817	4,689	1,687	941	7,794
University of Utah	37,830	59,473	53,154	19,382	17,628	187,467
Utah State Agricultural College	1,688	2,292	4,218	0	0	8,198
VERMONT	9,740	17,162	7,080	8,081	5,944	48,967
Norwich University	8,214	16,641	7,080	6,241	5,944	44,070
University of Vermont	1,526	521	0	2,840	0	4,887
VIRGINIA	72,041	184,949	195,086	122,018	88,830	662,824
College of William and Mary	0	0	436	0	0	436
Hampton Institute	0	9,808	23,170	18,404	0	51,140
University of Richmond	0	5,113	29,313	16,689	12,382	75,469
University of Virginia	26,810	38,749	42,087	23,635	16,428	147,853
Virginia Military Institute	2,300	4,053	5,647	2,308	1,771	16,080
Virginia Polytechnic Institute	42,922	89,193	77,718	58,466	24,873	209,589
Virginia State College for Negroes	0	7,738	18,020	7,678	1,888	30,151
Virginia Union University	0	0	998	1,619	0	2,617
WASHINGTON	26,311	63,067	92,589	63,129	29,981	266,[illegible]
Gonzaga University	380	1,410	2,370	0	0	4,160
State College of Washington	4,958	6,940	9,014	1,290	622	22,[illegible]
University of Washington	20,973	55,617	71,149	61,896	29,359	239,[illegible]
WEST VIRGINIA	78,706	94,998	131,596	87,417	23,282	384,[illegible]
West Virginia State College	0	1,033	9,296	7,320	2,203	19,852
West Virginia University	78,706	93,965	122,331	80,094	21,089	364,182
WISCONSIN	14,407	148,888	284,684	199,478	110,226	688,[illegible]
Marquette University	3,070	20,879	21,430	6,722	0	54,101
University of Wisconsin	11,337	128,009	263,454	192,756	110,226	605,782
WYOMING	5,553	12,147	17,417	7,348	2,988	45,453
University of Wyoming	5,553	12,147	17,417	7,348	2,988	45,453
ALASKA	0	0	0	0	682	682
University of Alaska	0	0	0		682	682
DISTRICT OF COLUMBIA	99,640	306,022	188,451	186,847	102,296	773,318
Catholic University of America	7,373	34,387	40,163	40,961	35,067	164,551
George Washington University	46,740	108,842	89,017	84,721	52,831	375,651
Howard University	45,527	62,842	60,281	61,165	16,348	231,678
HAWAII	0	0	0	0	2,758	2,758
University of Hawaii	0	0	0	0	2,758	2,758
PUERTO RICO	4,640	6,413	10,390	0	0	21,443
University of Puerto Rico	4,640	6,413	10,390	0	0	21,443

Table VI shows the distribution of the total expenditures made by each institution during its participation in the program into the principal subdivisions used in the ESMWT accounting system. As in table V, all figures are rounded off to the nearest whole dollar and the United States totals do not agree with the sum of the State totals.

In this table column 5 (Total) contains for each institution the same figure which appears in the "All Programs" column of table V, namely, the total expenditure of ESMWT funds by the institution during its participation in the program. The first three columns show the distribution of this sum among the three main accounts used in the financial records of ESMWT, namely (A) General Administration, (B) Instruction, and (C) Maintenance and Operation of Plant.

Column 6 ("Equipment") shows for each institution the total amount it expended from ESMWT funds for the purchase and rental of equipment. Since every item of equipment was charged to one of the three main accounts (A), (B), or (C), it is evident that the sums listed in column 6 form a part of a different classification of expenditures from the one set forth in columns 1, 2, and 3, and therefore are not added to their sum to obtain total expenditures.

This table is also included as a matter of record only, and no interstate or interinstitutional comparisons are implied.

Table VI.—Total Expenditures and Expenditures for Equipment for All Programs, by State and Institution

Institution, by State	General administration	Instruction	Maintenance and operation of plant	Total	Equipment
1	2	3	4	5	6
UNITED STATES TOTAL[1]	$14,523,616	$40,443,808	$4,998,619	$59,967,040	$3,366,793
ALABAMA	543,440	1,273,488	136,484	1,953,412	58,744
Alabama Polytechnic Institute	242,766	706,794	68,371	1,017,931	21,480
University of Alabama	300,674	566,694	68,113	935,481	37,264
ARIZONA	706	13,340	634	14,680	694
University of Arizona	706	13,340	634	14,680	694
ARKANSAS	26,853	63,791	4,513	95,157	2,191
University of Arkansas	26,853	63,791	4,513	95,157	2,191
CALIFORNIA	1,822,301	4,791,000	528,617	7,141,918	375,017
California Institute of Technology	268,408	793,331	60,209	1,122,018	44,401
Occidental College	1,585	2,108	208	3,901	191
San Jose State College	1,580	10,873	80	12,316	24
Stanford University	149,306	323,376	40,137	513,018	20,150
University of California	1,042,540	2,252,477	306,537	3,601,554	198,151
University of Redlands	3,019	8,490	491	12,000	745
University of Santa Clara	17,765	71,786	3,636	93,208	9,088
University of Southern California	357,906	1,328,465	97,275	1,783,646	96,286

[1] United States totals do not check sum of State totals, due to cumulative error caused by rounding off institutional totals.

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Table VI.—Total Expenditures and Expenditures for Equipment for All Programs, by State and Institution—Continued

Institution, by State	General administration	Instruction	Maintenance and operation of plant	Total	Equipment
1	2	3	4	5	6
COLORADO	121,653	474,291	41,088	637,032	48,653
Colorado School of Mines	41,814	84,503	1,030	127,347	10,036
Colorado State College	3,897	23,205	745	27,847	8,146
Regis College	22	216	29	267	9
University of Colorado	52,429	230,045	17,752	300,226	16,682
University of Denver	23,491	136,322	21,532	181,345	13,790
CONNECTICUT	298,196	620,073	88,502	1,006,771	54,549
University of Connecticut	150,632	400,626	60,511	611,769	44,750
Yale University	147,564	219,447	27,991	395,002	9,799
DELAWARE	11,700	52,059	9,809	73,568	2,773
University of Delaware	11,700	52,059	9,809	73,568	2,773
FLORIDA	136,117	244,067	46,593	426,777	37,535
University of Florida	136,117	244,067	46,593	426,777	37,535
GEORGIA	30,148	174,893	7,174	212,215	16,574
Atlanta University	3,802	11,293	2,752	17,847	1,157
Georgia School of Technology	26,346	163,600	4,422	194,368	15,417
IDAHO	1,458	8,215	504	10,177	741
University of Idaho	1,458	8,215	504	10,177	741
ILLINOIS	977,629	2,902,744	502,035	4,382,408	275,874
Bradley Polytechnic Institute	20,404	52,289	9,118	81,811	4,170
Central YMCA College	26,433	59,351	10,324	96,128	5,307
De Paul University	74,900	204,241	27,583	306,714	5,362
Illinois Institute of Technology	519,048	1,562,131	331,364	2,412,543	176,109
Lake Forest College	42	1,066	75	1,183	0
Loyola University	1,027	1,630	390	3,047	56
Northwestern University	41,757	222,334	30,206	294,297	24,975
University of Chicago	43,820	194,469	31,420	269,739	28,938
University of Illinois	247,939	597,351	70,583	915,873	32,946
Wheaton College	2,469	7,843	982	11,293	134
INDIANA	770,433	1,237,346	144,219	2,151,997	121,994
Butler University	878	6,740	487	8,095	917
Indiana University	91,427	231,879	16,900	340,206	2,039
Purdue University	627,049	917,285	107,650	1,651,984	103,035
Rose Polytechnic Institute	16,857	67,888	9,039	93,784	7,889
University of Notre Dame	34,222	113,453	10,173	157,848	8,039
IOWA	43,849	266,724	19,379	329,952	21,438
Drake University	5,193	8,633	2,090	15,916	419
Iowa State College	2,067	78,018	4,907	84,992	2,548
St. Ambrose College	167	1,177	124	1,468	288
State University of Iowa	36,422	178,896	12,258	227,586	18,493
KANSAS	185,514	585,539	82,148	853,199	49,683
Kansas State College	44,308	106,417	8,398	159,123	11,708
University of Kansas	141,206	479,122	73,748	694,076	37,975
KENTUCKY	67,898	200,737	21,919	290,524	20,887
University of Kentucky	45,832	126,072	16,082	187,986	11,699
University of Louisville	22,066	74,665	5,837	102,568	9,178

Table VI.—Total Expenditures and Expenditures for Equipment for All Programs, by State and Institution—Continued

Institution, by State	General administration	Instruction	Maintenance and operation of plant	Total	Equipment
1	2	3	4	5	6
LOUISIANA	89,584	332,669	38,495	461,138	23,030
Centenary College of Louisiana	5,651	16,566	3,161	25,378	1,202
Dillard University	492	1,941	351	2,794	162
Louisiana Polytechnic Institute	20,494	77,983	13,699	112,176	2,727
Louisiana State University	7,206	35,035	461	42,692	2,435
Loyola University	12,144	68,349	1,840	82,333	1,704
Southern University and Agricultural and Mechanical College	2,274	9,025	1,076	12,375	698
Southwestern Louisiana Institute	1,135	6,974	362	8,472	1,347
Tulane University of Louisiana	40,588	146,796	17,884	204,988	12,674
MAINE	33,370	107,841	16,908	158,119	6,687
Bates College	722	6,518	713	7,953	187
University of Maine	32,648	101,323	16,195	150,166	6,500
MARYLAND	176,408	688,939	117,243	982,650	86,419
Johns Hopkins University	85,098	274,160	55,212	414,470	56,878
University of Baltimore	24,664	41,747	7,299	73,710	1,099
University of Maryland	66,706	373,032	54,732	494,461	28,942
MASSACHUSETTS	398,887	1,530,686	248,561	2,178,134	148,777
American International College	3,897	11,996	1,797	17,690	516
Boston College	4,940	52,532	5,411	62,883	3,363
Boston University	3,318	26,536	4,308	34,162	1,921
Clark University	968	3,577	365	4,910	476
Harvard University	125,507	530,172	64,294	720,968	62,547
Lowell Textile Institute	3,064	19,806	2,679	25,549	674
Massachusetts Institute of Technology	100,173	426,561	108,666	636,400	38,027
Massachusetts State College	2,495	16,590	32	19,095	995
Northeastern University	132,851	272,799	42,326	497,976	17,344
Simmons College	2,951	9,660	2,144	14,755	360
Smith College	227	3,003	618	3,848	119
Tufts College	45,340	61,580	8,951	116,270	12,996
Wellesley College	54	1,703	349	2,096	346
Worcester Polytechnic Institute	8,369	53,842	5,801	68,006	6,250
MICHIGAN	336,166	1,211,385	124,813	1,672,364	85,908
Detroit Institute of Technology	39,707	81,436	20,752	141,894	3,838
Lawrence Institute of Technology	52,454	140,284	23,246	215,984	10,060
Michigan College of Mining and Technology	11,340	33,106	5,714	50,160	1,694
Michigan State College	36,582	132,782	10,036	179,330	11,365
University of Detroit	46,020	115,908	25,783	187,316	7,069
University of Michigan	72,913	364,570	22,569	460,052	22,100
Wayne University	77,544	383,290	6,606	428,450	25,752
MINNESOTA	97,224	543,696	27,951	668,611	49,237
St. Olaf College	259	2,235	110	2,604	179
University of Minnesota	96,965	541,411	27,841	666,207	49,059
MISSISSIPPI	68,001	204,638	30,617	303,251	17,763
Mississippi State College	63,531	192,051	29,062	283,646	16,356
University of Mississippi	5,470	12,582	1,555	19,607	1,407
MISSOURI	154,247	487,400	80,191	721,838	42,663
Lincoln University	3,509	4,161	118	8,048	199
Missouri School of Mines and Metallurgy	9,972	65,749	11,680	86,305	7,664
St. Louis University	26,231	55,000	7,760	[illegible]	3,190
University of Missouri	52,069	53,721	14,905	[illegible]	7,850
Washington University	63,514	270,940	44,721	[illegible]	20,838
MONTANA	11,298	87,698	3,364	72,368	5,137
Montana School of Mines	1,091	3,444	735	5,248	994
Montana State College	10,207	54,262	2,615	67,118	4,[illegible]

Table VI.—Total Expenditures and Expenditures for Equipment for All Programs, by State and Institution—Continued

Institution, by State	General administration	Instruction	Maintenance and operation of plant	Total	Equipment
1	2	3	4	5	6
NEBRASKA	50, 904	157, 909	13, 735	222, 548	13, 748
University of Nebraska	50, 904	157, 909	13, 735	222, 548	13, 748
NEVADA	1, 150	4, 821	251	6, 222	60
University of Nevada	1, 150	4, 821	251	6, 222	60
NEW HAMPSHIRE	41, 789	116, 596	10, 902	169, 286	15, 400
Dartmouth College	11, 389	28, 275	6, 255	45, 919	3, 637
University of New Hampshire	30, 400	88, 320	4, 647	123, 367	11, 763
NEW JERSEY	695, 337	1, 738, 374	227, 586	3, 661, 297	94, 902
Newark College of Engineering	153, 017	221, 993	47, 983	422, 993	10, 599
Princeton University	32, 776	86, 020	11, 520	130, 325	10, 229
Rutgers University	423, 210	1, 139, 193	113, 876	1, 676, 279	69, 555
Stevens Institute of Technology	62, 661	226, 974	43, 403	333, 038	12, 875
University of Newark	23, 673	64, 483	10, 804	98, 962	1, 644
NEW MEXICO	25, 963	86, 197	11, 737	125, 917	14, 925
New Mexico College of Agriculture and Mechanic Arts	296	1, 907	0	2, 203	361
University of New Mexico	25, 667	84, 290	11, 737	121, 714	14, 564
NEW YORK	1, 133, 142	4, 096, 126	474, 480	5, 705, 747	261, 002
Brooklyn College	2, 694	13, 942	0	16, 636	815
Canisius College	1, 626	14, 342	1, 148	17, 015	1, 107
City College of the College of the City of New York	130, 353	354, 433	12, 698	497, 484	22, 610
Clarkson College of Technology	35, 415	174, 415	17, 747	227, 577	6, 420
Columbia University	83, 544	192, 031	13, 911	289, 486	11, 869
Cooper Union Institute	719	14, 492	1, 094	16, 305	1, 626
Cornell University	177, 813	765, 864	79, 002	1, 022, 679	51, 441
Defense Training Institute	79, 957	306, 860	36, 117	422, 934	7, 805
Hofstra College	10, 128	27, 978	3, 028	41, 134	1, 206
Hunter College	8, 296	35, 679	2, 200	46, 115	959
Long Island University	24, 317	95, 030	18, 219	137, 566	6, 814
Manhattan College	103, 855	343, 010	30, 966	477, 831	29, 144
New York University	107, 900	349, 408	79, 181	536, 347	26, 944
Niagara University	28, 031	45, 911	10, 448	84, 390	1, 188
Polytechnic Institute of Brooklyn	52, 803	251, 461	18, 037	322, 301	16, 371
Pratt Institute	42, 701	155, 193	24, 031	221, 925	4, 218
Rensselaer Polytechnic Institute	41, 740	196, 646	28, 967	267, 353	9, 225
St. Bonaventure College	16, 329	32, 169	5, 521	54, 019	2, 972
St. John's University	3, 451	7, 116	764	11, 331	1, 098
Syracuse University	84, 132	233, 175	27, 637	344, 944	13, 287
Union College	41, 044	137, 246	29, 297	208, 547	15, 273
University of Buffalo	62, 847	194, 666	24, 626	282, 140	9, 676
University of Rochester	28, 726	151, 852	10, 240	188, 818	9, 492
Vassar College	122	5, 368	691	6, 061	0
NORTH CAROLINA	102, 882	740, 180	62, 431	865, 193	70, 814
Agricultural and Technological College of North Carolina	4, 671	36, 655	4, 618	45, 944	3, 675
Duke University	5, 370	50, 146	3, 854	62, 370	6, 870
North Carolina College for Negroes	12, 526	53, 713	7, 551	72, 790	5, 096
North Carolina State College	69, 784	565, 037	23, 510	658, 331	52, 543
University of North Carolina	7, 231	34, 629	2, 899	44, 769	1, 630
NORTH DAKOTA	12, 994	84, 760	6, 449	104, 163	11, 521
North Dakota Agricultural College	2, 368	13, 623	4, 735	20, 726	1, 723
University of North Dakota	10, 616	71, 127	1, 714	83, 457	9, 798

Table VI.—Total Expenditures and Expenditures for Equipment for All Programs, by State and Institution—Continued

Institution, by State	General administration	Instruction	Maintenance and operation of plant	Total	Equipment
1	2	3	4	5	6
OHIO	617,749	1,880,711	304,655	2,753,083	165,991
Antioch College	12,870	21,117	2,838	36,826	1,571
Case School of Applied Science	102,834	412,764	91,851	607,449	43,489
Fenn College	148,275	311,030	47,749	592,064	29,006
Heidelberg College	1,991	5,804	355	8,150	969
Miami University	6,940	41,798	6,337	55,075	717
Ohio Northern University	42,616	106,138	21,159	169,913	7,941
Ohio State University	72,576	243,403	11,754	327,733	19,646
Ohio University	33,061	119,106	11,099	163,256	9,381
University of Akron	27,324	88,435	14,839	130,888	3,338
University of Cincinnati	33,765	109,422	5,723	148,910	10,228
University of Dayton	15,929	38,915	5,459	60,294	1,783
University of Toledo	85,107	256,007	74,832	415,946	31,002
Western Reserve University	35,494	95,228	9,307	140,019	5,363
Wilberforce University	1,944	5,034	0	6,678	606
Youngstown College	2,142	6,510	1,340	9,998	1,024
OKLAHOMA	180,038	528,959	68,383	777,390	40,121
Langston University	7,016	17,000	3,839	27,855	778
Oklahoma Agricultural and Mechanical College	20,335	91,460	12,467	133,271	12,067
Oklahoma City University	23,660	63,243	7,553	94,456	3,093
University of Oklahoma	104,020	313,750	40,154	457,933	21,475
University of Tulsa	16,017	43,498	4,360	63,875	2,132
OREGON	20,558	72,214	394	93,166	6,087
Oregon State College	20,558	72,214	394	93,166	6,087
PENNSYLVANIA	3,494,158	6,806,623	945,969	11,226,650	708,682
Bryn Mawr College	1,696	10,564	662	12,922	1,135
Bucknell University	2,774	42,930	3,412	49,116	4,686
Carnegie Institute of Technology	167,906	371,294	42,816	581,946	58,778
Drexel Institute of Technology	140,730	570,682	49,101	760,472	42,045
Franklin and Marshall College	26,612	66,160	9,735	91,507	140
Grove City College	3,860	12,702	6,305	22,867	2,065
Haverford College	4,298	17,920	1,098	23,316	1,408
Lafayette College	13,865	49,903	14,611	78,379	3,416
Lehigh University	9,311	46,849	9,706	65,866	5,363
Muhlenberg College	8,594	30,198	9,219	47,999	811
Pennsylvania Military College	1,818	3,479	868	6,165	367
Pennsylvania State College	2,389,547	3,376,157	387,344	6,153,048	371,580
St. Joseph's College	9,487	28,228	4,105	41,770	3,081
Swarthmore College	33,657	146,216	21,080	200,953	6,942
Temple University	141,974	467,530	44,380	653,884	19,992
University of Pennsylvania	194,695	656,380	37,729	888,784	48,580
University of Pittsburgh	301,678	902,711	193,969	1,397,358	132,018
Villanova College	37,753	106,206	9,374	143,333	11,355
Wilson College	77	700	100	877	0
RHODE ISLAND	129,960	280,404	43,468	453,832	10,343
Brown University	36,485	132,291	15,473	184,249	6,577
Rhode Island State College	93,475	148,113	27,995	269,583	3,766
SOUTH CAROLINA	43,081	224,155	24,428	301,663	16,007
The Citadel	17,547	75,383	11,420	104,349	4,966
Clemson Agricultural College	14,080	59,322	5,468	78,869	5,081
Colored Normal, State Agricultural and Mechanical College	1,804	16,062	608	18,394	1,679
Furman University	240	2,238	100	2,578	0
University of South Carolina	10,410	69,654	6,609	86,693	4,439
SOUTH DAKOTA	6,134	16,894	756	23,784	1,083
South Dakota State College	6,134	16,894	756	23,784	1,083

Table VI.—Total Expenditures and Expenditures for Equipment for All Programs, by State and Institution—Continued

Institution, by State	General administration	Instruction	Maintenance and operation of plant	Total	Equipment
1	2	3	4	5	6
TENNESSEE	78, 402	368, 070	42, 374	478, 846	15, 816
Fisk University	28	420	35	483	0
Tennessee Polytechnic Institute	205	1, 022	66	1, 293	190
University of Tennessee	41, 441	232, 144	26, 332	299, 917	7, 940
Vanderbilt University	36, 728	130, 484	15, 841	174, 053	8, 877
TEXAS	831, 936	2, 768, 731	376, 096	3, 966, 784	268, 324
Agricultural and Mechanical College of Texas	229, 092	997, 879	93, 307	1, 320, 678	86, 009
Baylor University	5, 580	17, 312	1, 144	24, 016	894
East Texas State Teachers College	50	547	0	600	0
Hardin-Simmons University	1, 608	5, 289	1, 010	8, 907	885
Northern Texas State Teachers College	5, 588	17, 380	220	23, 188	369
Rice Institute	2, 946	34, 165	4, 324	41, 435	385
Southern Methodist University	119, 943	607, 841	66, 418	694, 202	37, 482
Texas Christian University	14, 830	56, 535	2, 848	71, 160	6, 354
Texas College of Arts and Industry	28, 084	97, 880	11, 714	138, 678	6, 266
Texas College of Mines and Metallurgy	4, 477	18, 328	1, 317	23, 122	911
Texas Technological College	36, 802	148, 219	11, 027	196, 048	18, 022
University of Houston	3, 750	17, 904	4, 833	26, 588	169
University of Texas	281, 889	994, 338	86, 605	1, 362, 232	88, 800
West Texas State Teachers College	1, 035	5, 897	0	6, 932	465
UTAH	28, 669	161, 378	13, 342	203, 419	23, 909
Brigham Young University	2, 069	5, 045	680	7, 794	381
University of Utah	26, 085	148, 867	12, 505	187, 457	22, 807
Utah State Agricultural College	545	7, 466	157	8, 168	745
VERMONT	14, 561	31, 042	3, 354	48, 957	3, 734
Norwich University	13, 733	27, 163	3, 174	44, 070	3, 324
University of Vermont	828	3, 879	180	4, 887	410
VIRGINIA	169, 894	426, 781	58, 949	655, 624	32, 981
College of William and Mary	160	330	0	490	0
Hampton Institute	12, 670	38, 055	3, 415	51, 140	2, 482
University of Richmond	14, 189	54, 939	6, 330	75, 458	4, 113
University of Virginia	34, 496	113, 906	9, 454	157, 856	7, 785
Virginia Military Institute	2, 686	11, 917	1, 506	16, 089	492
Virginia Polytechnic Institute	50, 080	186, 085	36, 794	272, 959	14, 886
Virginia State College for Negroes	6, 403	19, 684	6, 094	32, 181	2, 803
Virginia Union University	332	1, 890	345	2, 567	280
WASHINGTON	29, 280	225, 800	10, 422	265, 502	8, 120
Gonzaga University	196	3, 794	171	4, 160	361
State College of Washington	7, 369	14, 290	540	22, 198	873
University of Washington	21, 725	207, 780	9, 715	239, 199	7, 897
WEST VIRGINIA	67, 631	267, 631	28, 804	364, 066	12, 413
West Virginia State College	4, 524	14, 727	603	19, 854	814
West Virginia University	63, 107	252, 874	28, 201	344, 182	11, 599
WISCONSIN	235, 065	685, 361	68, 467	988, 893	53, 307
Marquette University	14, 304	34, 144	5, 669	54, 10[illegible]	4, 406
University of Wisconsin	220, 761	651, 217	62, 774	934, 7[illegible]	48, 901
WYOMING	5, 074	37, 167	3, 171	45, 422	1, 380
University of Wyoming	5, 074	37, 167	3, 171	45, 422	1, 380
ALASKA	209	414	0	623	0
University of Alaska	209	414	0	623	0

Table VI.—Total Expenditures and Expenditures for Equipment for All Programs, by State and Institution—Continued

Institution, by State	General administration	Instruction	Maintenance and operation of plant	Total	Equipment
1	2	3	4	5	6
DISTRICT OF COLUMBIA	206,191	480,989	85,034	772,215	43,920
Catholic University of America	22,229	111,281	20,981	154,891	4,810
George Washington University	103,048	226,457	41,540	375,051	14,508
Howard University	80,914	144,269	23,507	251,673	24,602
HAWAII	350	2,163	240	2,753	280
University of Hawaii	350	2,163	240	2,753	280
PUERTO RICO	2,043	19,300	100	21,443	1,707
University of Puerto Rico	2,043	19,300	100	21,443	1,707

INSTITUTIONAL HISTORIES

Near the close of the program institutional representatives were requested to send to the Washington office brief statements of interesting developments during their ESMWT program, such as new techniques of teaching or for the training and supervision of teachers, new and more helpful relations between the institution and industry, and outstanding or unique contributions to the war effort resulting from ESMWT courses conducted by the institution.

Many helpful statements and a number of formal institutional histories were received from the institutions and are included in the Historical Collection which will be maintained in the Office of Education. They contain many suggestions which should be helpful to any institution planning to inaugurate courses of the general type conducted under ESMWT.

Chapter VIII
APPRAISALS OF THE PROGRAM

AS STATED in chapter III, continuous evaluations were made of the effectiveness of the program and of the results being attained, through specific appraisive studies and continuous evaluations of letters received from governmental and industrial executives, as well as through discussions at meetings of the National Advisory Committee and of the Regional Advisers. All of the methods of evaluating the results of the program were of great value to the Director and his staff in the formulation of policies and procedures for the program. Brief outlines of the principal studies follow.

"ARE THE EDT-ESMDT PROGRAMS EXPEDITING DEFENSE?"

An analysis of more than 1,000 letters from industrial and governmental executives expressing opinions as to the effectiveness of this program in expediting defense was prepared by the field coordinator in the fall of 1941 and was published in the *Journal of Engineering Education* in February 1942, under the title stated above. Most of the letters were commendatory.

A few of the letters contained critical comments regarding individual courses and suggested improvements in certain details of administration, but for the most part the writers indicated general approval of the program. A large majority of the writers felt that the program was making a definitely helpful contribution to defense production.

The constructive criticisms were utilized by the Washington staff and the institutions in improving the services of the program to defense industries. These suggestions pertained chiefly to the organization and conduct of courses and to the selection of teachers and students.

Suggestions as to the organization of courses were well summarized by one industrialist who wrote "In all cases where these courses have been set up in conjunction with, and tailored to fit, the requirements of the ————Corporation, the results have been extremely happy for all concerned."

The most frequent criticisms as to the conduct of courses contained such expressions as "too academic," "not specific enough," "not given enough practical training," indicating that some teachers apparently had difficulty in adjusting their thinking and their teaching methods to the idea of specific training for specific jobs, as distinguished from general education.

At least 80 percent of the letters expressed definite interest in and approval of the program. The following excerpt from a letter written by the chief industrial engineer of a large woolen company is representative of such statements:

I think the greatest evidence of the value of your work is to tell you that I am planning to copy your methods and give a similar course to the Overseers and Foremen of our company during the coming winter. . . . It is impossible to get new machinery and the supply of skilled labor in this community is exhausted . . . the only other way we can see to meet the increased production caused by government orders is to increase the productivity of what machinery and what skilled help we have and the only way to do it is through the methods you have so ably taught in your classes. One of our engineers is now completing plans for rearranging one large department so that the same production can be obtained with 25 percent less help and thereby releasing these people to form a third shift.

Among general conclusions expressed in this study were the following:

(1) Need was indicated for close coordination of the program with industry and with other training programs.
(2) Courses should always be organized to meet known or anticipated needs of defense industries as determined by consultation with industrial executives, and not to serve as parts of a general educational program.
(3) Men chosen from industry may be better teachers for certain ESMDT courses than available regular faculty members, but might require rather careful educational supervision to insure optimum results.
(4) "It must always be borne in mind that this is an intensive training program rather than an educational one, that its primary objective is to expedite defense production, and that all other benefits, real and valuable as they may be, are secondary."

OCCUPATIONS OF ESMDT TRAINEES

In the spring of 1942 the institutions were asked to supply the Director with the following information:

(1) Number and percentage of ESMDT trainees, now in training, who at present are employed by industries which have war contracts, or by the Army and Navy.
(2) Percentage of ESMDT trainees, now in training, who are not now employed in industries with war contracts, the Army or the Navy, but are planning to enter the employ of such industries upon completion of their ESMDT courses.

This information had been requested by the Bureau of the Budget. The 96 replies from institutions which were received in time to be incorporated into the reply sent to the Bureau of the Budget reported that 64 percent of their current ESMDT trainees were employed by industries having war contracts or by the Army and Navy, and that an additional 28 percent planned to enter such employment upon completion of their courses.

RESULTS OF TRAINING UNDER THE ESMDT PROGRAM

In the early fall of 1942, the institutions were requested to submit estimates of their institutional programs through the fiscal year 1943–44 under the heading of "Estimated Needs for Training" in each of the four fields covered by the program; the capacity of the institution to offer

courses, both on-campus and off-campus, in the program; estimates of enrollments and types of courses to be proposed, divided into preemployment training and in-service training of war workers; and the percentage of trainees who would enter war work upon the completion of the courses. They were also asked to supply data as to the services rendered to specific war industries by the courses comprising the institutional programs.

Abstracts of the reports received from 121 institutions in response to this request were published in the *Journal of Engineering Education* of the Society for the Promotion of Engineering Education, December 1942. Some impressive accomplishments were reported, and the general picture presented indicated that close relations had been established between the participating institutions and the industries they served, and that because of the impending shortages of skilled technicians industry was notably interested in the program. A high percentage of the trainees were either employed in war industries or definitely planning to enter such industries upon completion of courses.

SPECIFIC CONCRETE EVIDENCES OF BENEFITS TO THE WAR EFFORT

In the spring of 1943 the institutions were asked to send to the Director statements, preferably directly from industrial executives, containing definite quantitative illustrations of benefits to the war effort of their companies (as distinguished from benefits to individuals) resulting from ESMWT courses.

Hundreds of letters were received in response to this request, the great majority of them being letters written by industrial executives setting forth experiences of their companies with ESMWT courses. These letters contained many statements of specific benefits to the war effort from these courses. They abound in statements similar in tone to one stating that the Federal Government had been saved "many times the cost of the courses due to . . . increased knowledge of textiles and consequent ability to properly classify textile materials . . ." on the part of members of the customs service. Increased revenue to the United States was estimated in this instance at "some hundreds of thousands of dollars."

Other letters contained such phrases as "261 percent increase in production" (in a course in Tooling Engineering), "100 percent increase in production" (in a course in Production Supervision), "200 percent to 300 percent increase in production" (in a course for the training of foremen), "355 percent increase in production on one unit" (in a course in Time and Methods Study), "accident rates reduced by 66⅔ percent" (in a course in Safety Engineering).

"A CRITICAL ANALYSIS OF ESMWT COURSES"

In the fall of 1943 the Field Coordinator, at the request of the National Advisory Committee, made a critical study of the courses offered in the program. This study was published in the November 1943, issue of the *Journal of Engineering Education* and was distributed to the institutional representatives and the members of both advisory groups.

It was pointed out in the study that the breadth of the field assigned to ESMWT and the wide range of subject matter included in the list of courses approved by the Chairman of the War Manpower Commission made a general analysis of the program extremely difficult, and imposed serious limitations of applicability upon any statistical study of the courses offered. It was also pointed out that "ESMWT is essentially not a national program, but a large number of local programs, and national averages may or may not fit particular local situations"; that each institution is charged with the responsibility of determining changes in local training needs and of keeping abreast of trends of employment; that, in general, no two ESMWT courses are alike; and that "it has been the intention of those in charge of the program ever since its inception to avoid standardization and to keep the program flexible, able to meet local needs as they arise, to follow the general trends of war industries, and hence to give maximum service to the war effort."

These considerations led to the conclusion that "the only method of analysing the program which will yield significant results is a separate analysis of each individual course, to ascertain if it is organized and conducted in accordance with the intent of Congress; combined with a consideration of trends in enrollments, to determine whether the program is responsive to changing industrial needs; and followed by a study of the results obtained, as measured by the placement of trainees and by the benefits derived from the program by industry and Government."

The study proceeded with an analysis of trends in enrollments in various types of courses, indicating that, in general, the enrollment had about paralleled changing needs in the war industries. It was followed with a discussion of the results of training as exemplified in employment records of trainees and in the benefits to war industries cited by many industrial executives.

The final conclusions reached in this analysis were that:

> The ESMWT program has realized the objectives of its originators. It is a flexible program, able to adjust itself to changes in war industries, and to meet local training needs as they arise. It seems evident that courses are offered in an attempt to fill definite and specific needs of war industries, and not simply because they have been offered in the past, nor merely to fit the wishes of individual trainees. The Washington staff has been vigilant in attempting to make certain that every course proposed by the colleges complies with the specifica-

tions laid down by the Act and the Regulations. But probably the greatest assurance that ESMWT courses are being conducted in accordance with the intent of Congress lies in the fact that those in charge of the institutional programs are responsible persons of honesty and integrity, that each participating college assumes full responsibility for all the courses which it offers, and that each college is very naturally jealous of its reputation and eager to maintain and expand the good will of the industries and Governmental agencies which may be expected to use the products of its regular curricula. The most effective way in which they can accomplish this purpose is by giving these agencies satisfactory service, and by making every possible effort to assure that the trainees in its ESMWT courses receive training which is as adequate and effective for its intended purposes as is the education of the regular students of the college for its intended purposes.

The belief that these efforts are meeting with general success appears to be well established by employment records of trainees and by the many letters received from industrial and Governmental executives, testifying to the benefits derived by their companies or agencies from ESMWT courses. It seems evident that the training has helped to make possible faster, more efficient and more economical production of vital war materials . . . to say nothing of the many "byproduct" values which have resulted. It is impossible to determine objectively the precise monetary value of ESMWT to the Nation or its exact effect on the war effort. There seems to be no room for doubt, however, that it has rendered service which has been out of all proportion to its cost.

CASE HISTORIES

In December 1943, the institutions were asked to provide information as to accomplishments of their ESMWT programs in the form of "case histories." It was suggested that these case histories might deal with one or more selected classes, showing the industrial service records of the trainees following completion of the course; or brief accounts of all the training assistance rendered to one or more selected companies.

In response to this request institutions in all parts of the country submitted "case histories" showing important services rendered to war industries through training afforded their employees in ESMWT courses. Many of the reports dealt with advancements received by ESMWT trainees as a direct result of their training and as indicated by new positions, increased responsibilities, greater effectiveness, and increased salaries. Other reports dealt with directly measurable gains in war production achieved by the companies served as a direct result of the increased effectiveness of employees following completion of ESMWT courses.

Some reported results of courses in Quality Control by Statistical Methods were quoted in chapter IV, page 54. The following brief statements are merely samples of information contained in the "case histories."

A shipbuilding company reported that courses in engineering and in foremanship given to its personnel were responsible for "savings of at least three-fourths of a million dollars a year."

Other reports contained such statements of valuable contributions to the war effort as "50 percent reduction in defects with a greater reduction in man hours"; "savings of 15 percent to 50 percent in materials, accompanied by savings of 20 percent to 75 percent in manpower"; "accident rate reduced from 68.65 to 7.58 and severity reduced from 0.586 to 0.089."

Instances of benefits to individual trainees were numerous. The University of California reported that 32 women who completed the first full-time course in Engineering Drawing for Women given by the University were all placed in war plants, and 2½ years later 25 were still working in full-time war jobs. During this time the salaries earned by the group had increased from a range of 70 to 90 cents to a range of 70 cents to $1.65 per hour. None of these women had previous industrial experience.

The Stevens Institute of Technology reported on a group of women who took their ESMWT course in Introduction to Engineering. They reported that "In each case the girl has advanced herself both in duties she performs and in rate of pay. The beginning pay average for the group of girls was approximately $30.51 per week and the present pay average is $41.54 per week." None of these women had previous industrial experience.

"HOW WELL IS THE ESMWT PROGRAM SERVING WAR PRODUCTION TRAINING NEEDS?"

A study under this title by Dr. Roy W. Bixler, educational statistician of ESMWT, was published in the April 1944, issue of the *Journal of Engineering Education*.

The study had two closely related objectives: (1) To determine how well the program was succeeding in placing training activities in the localities where war production was going forward, and (2) to determine how sensitive and responsive the program was to the conditions of the labor market.

The study, under the first of these objectives, consisted of a comparison between the dollar volume of war production by States as reported by the War Production Board on November 1, 1943, and the volume of ESMWT training activity as measured by enrollments in classes in operation on November 30, 1943. The States were ranked on these two indices and the correlation of the ranks obtained.

The over-all correlation for the entire program from 1940 to 1943 was found to be 0.89, which is positive and large enough to be regarded as significant. Furthermore, the variations from the over-all correlation which were found in individual States could in most cases be explained in terms of adjustments to peculiar situations.

The second objective was studied by determining to what extent training activity was being concentrated in areas of labor shortage, as reported by the War Manpower Commission. The ratio of ESMWT enrollments

per 100,000 population (1940 census figures) was selected as the most practical index of concentration of training.

The War Manpower Commission classified the areas in which there were actual or anticipated problems of labor supply in four groups defined as follows:

GROUP I. Areas of acute labor shortage.
GROUP II. Areas of labor stringency and those anticipating a shortage within 6 months.
GROUP III. Areas in which a slight labor surplus was expected to remain after 6 months.
GROUP IV. Areas in which a substantial labor surplus was expected to remain after 6 months.

To these were added a fifth group composed of all areas not included in Groups I to IV. It was assumed that in these areas problems of labor supply were even more remote than in group IV.

The results of the study are shown in table A.

Table A.—Trainees Per 100,000 Population and Percent of All Trainees in the Four Labor-Market Areas and All Other Areas, As of November 30, 1943

Labor market classification, by group	Trainees per 100,000 population	Percent of all trainees
I	277	33.7
II	170	27.3
III	153	13.9
IV	82	8.0
Other areas	28	17.1

The study led to the following general conclusions:

1. The highly significant correlations between the ranks of the States in volume of training and volume of war production justify the conclusion that ESMWT and its predecessors, ESMDT and EDT, have p' ced training in the localities where war production was going forward.

2. The concentration of training activity in areas of labor shortage warrants the conclusion that the 1943–44 ESMWT program is sensitive and responsive to the training needs created by conditions of the labor market in the war production program.

3. Therefore, the findings of this study warrant the general conclusion that ESMWT is serving the training needs created by the war production program.

A similar study was made of ESMWT classes active on October 19, 1944, which indicated a distribution of trainees as shown in table B. It will be noted that this study shows a considerably greater degree of concentration of training in areas of labor shortages than was indicated by the earlier study.

Table 8.—Percent of All Trainees in the Four Labor-Market Areas and All Other Areas, As of October 19, 1944

Labor-market classification, by group	Percent of all trainees
I	50.7
II	25.0
III	9.4
IV	9.9
Other areas	5.0

THE JACKSON-CARVIN REPORT

In May 1944, the Commissioner, believing that the program might be benefited by an impartial objective appraisal of its procedures and accomplishments, invited Dugald C. Jackson, professor emeritus of electrical engineering, Massachusetts Institute of Technology, and Frank D. Carvin, head of the Department of Mechanical Engineering, Newark College of Engineering, to undertake such an appraisal of ESMWT.

Dr. Jackson and Dr. Carvin examined the plans, procedures, and records of the Washington office, and visited about 50 participating institutions selected to represent the different types and sizes of institutions and the different parts of the country. On each of these visits examination was made of the courses being carried on by the institution and of the results being attained. Personal conferences were held with executive authorities of some 60 industries which had participated in the program, and correspondence conducted with many others and with the officers of many colleges which time did not permit visiting in person. In their report they state—

> We are justified in saying that all conclusions that we present in this report are derived from information secured by us from direct contacts either with those authorities of the colleges carrying on ESMWT work or with executives and employees of industries of which employees had pursued ESMWT courses; and in many instances the contact relating to a particular point was secured with both of these and confirmation was thus secured.

The report submitted by Doctors Jackson and Carvin to the Commissioner contains a brief account of the origin and early development of the program, an outline of the organization of the Washington staff and of the general background of its professional members, a brief description of the division of responsibilities between the Washington office and the participating institutions and of the general methods of administration of the program, and an outline of the procedures followed by the colleges and the Washington staff in setting up courses and in the statistical and financial accounting for them. The various types of training given under the program are mentioned, as are the subjects of regional coordination and cooperation with the War Manpower Commission. Statistics include the number of courses operated, the number of persons trained, and the

number of participating institutions. The statement is made that the plan of general supervision by the Washington office with "decentralization of operation of details at the colleges throughout the country, has proved to be a successful solution of an extremely difficult problem. Its success is demonstrated by the enthusiasm with which the work is usually carried on, and by the economy exhibited in both the central supervision and the field execution. The elasticity of procedure has enabled the provision, under the general supervision, of high-level training particularly adapted to needs of industry in every part of the country, without deviating from the general plan or missing the interpreted intent of the successive Congressional Acts".

The report points out that the types of industries benefited by the program include almost the entire range of industries participating in the war effort, and that they consist of both large and small industries. It is pointed out that many of the larger industries had maintained for many years training staffs conducting both vocational and college-level training for their employees. These industries, in general, proceeded with their training programs during wartime, with some acceleration, but even these companies often "found it desirable to utilize the services of ESMWT to fill gaps which the stress on manpower made it difficult for them to fill for themselves." The report continues—

> Other very large industries have started from a small nucleus when they came into the war effort and have become large (some very large) by the demands of war production, and these industries with their tremendously rapid growth of employees of all grades have been exceedingly pressed for appropriate training for upgrading their nucleus of older employees and for adequately training inexperienced men to take posts of moderate responsibility vacated by the promotion of the upgraded men. These industries have been greatly aided by the ESMWT and its predecessors through all types of courses (Engineering, Chemistry, Physics, and Production Supervision). The Executive Officers of many of these industries have made estimates of the savings in cost of production due to improved processes, savings in man-hours, and savings in waste material, which indicate a total money saving far larger than the total expenditures that have been made through the appropriations by Congress to EDT and up to and including ESMWT. Such estimates do not include the intangible advantages arising from accelerating the rate of war production which has resulted in a great many cases from the training.
>
> In the case of smaller industries which the conditions of war production have caused to expand at a rapid rate, in some instances to employee groups of many times former peacetime employment numbers, there usually have been no internal training organizations or even training plans available. Here, the arrangements of ESMWT and its predecessors for training at college level have played an essential part in providing necessary training for employees to enable upgrading and to make possible the introduction of inexperienced men into posts of some responsibility.
>
> The ESMWT work has, of course, been far more concentrated in those areas of the United States where there is a high concentration of industrial activity; but even in the areas of small industrial activity, ESMWT has found an appro-

priate place and has been helpful, particularly in preemployment training for industries which are themselves located in more dense industrial areas. The educational statistician of ESMWT has shown that close correlation exists between the number of ESMWT trainee enrollments and the money volume of war contracts in the various States.

A section of the report deals with the subject of employee stability, in which is discussed the instability of "drifters" and of women employees, and the beneficial results to industry of the ESMWT preemployment courses and courses in supervisory practices in reducing the turnover in skilled labor within war industries.

Mention is made of the difference in the industrial situation in the various parts of the country, with the resulting differences in training needs, and of the success of the ESMWT program, by means of its flexibility, in meeting these widely varied needs.

Instances of aids to large rapidly expanding industries in new fields and to smaller industries which had become prime contractors or subcontractors in war service, and specific examples of results attained and influences exerted by specific ESMWT courses are mentioned, particularly the program of instruction in Ultra-High Frequency Techniques and the courses in Quality Control by Statistical Methods. (See chapter VII).

The report discusses the different types of institutional programs which had developed in the program, such as (1) the program conducted entirely on the campus of an institution; (2) the program conducted partly on the campus and partly in rented quarters; (3) the program which was almost entirely an off-campus program and was conducted essentially as an extension program; and (4) the program in which training centers were organized in isolated industries, such as the big new war production plants set up in the various parts of the country for the shipbuilding, airplane, oil, and chemical industries.

The report also mentions the type of program conducted in large industrial centers where several institutions cooperated in the development of a program to serve the industries of the region, mentioning particularly the coordinators which were employed in certain areas.

In summing up their findings, the authors said:

> . . . we will say that the result of rather exacting examination on the ground into the actual performance by the colleges, with and for the industries in improving their war production, shows that the extent of aid to the war effort by the ESMWT and its predecessors has been so sufficient that it has returned more than once to the United States, in lessening cost of industrial output for war purposes, the total of the appropriations for this work expended by the United States through the administration of the U. S. Office of Education. In fact, our data lead us to the conclusion that the return to the United States in saving of costs and improving the quality of war production has been many times the actual cost in money put out through the appropriations.

It is quite impracticable to secure definite estimates of savings because many factors become involved which are in addition to the improved results derived from the college-level training of employees and supervisory officers; but we are convinced as a consequence of our special study that our conclusion is fully supported. The training of the executives and the lesser supervisory forces has had a great influence in bettering relations within many of the industries and of itself has had an influence for improving and increasing production in proportion to the number of employees employed. We again and again have found instances where the leading Executive Officers have flatly told us that after the training courses had been in effect, their employees became more studious-minded and more interested in making records in production of fine types of product than before the courses had been pursued by the same employees, and a marked decrease in labor turnover has been observed. We are not able to say that such results are wholly due to the ESMWT courses, but there is not the slightest doubt that at least a portion of the results, which on the whole amount to very large figures of money, in addition to advantages from acceleration of production, makes a large return to the United States as a consequence of the expenditures of the appropriated money for ESMWT and its predecessors.

The clearly shown serviceability to the war effort of the project of ESMWT and its predecessors has been so great that any lessening of the activities of this project before the fighting in this war is ended would be deeply unfortunate. Moreover, the centralized supervision in the Office of Education accompanied with decentralized execution carried out by colleges in contact with industry has proved so satisfactory that there is no need for changes in the plan.

STUDY OF EFFECTS OF PROGRAM CURTAILMENT

As stated in chapter IV, page 35, the institutions were asked in November 1944, to reduce their programs by limiting proposals for courses to those having "immediate application in meeting clear-cut, urgent needs of war industry." The new procedures were discussed in advance with the National Advisory Committee and the regional advisers. They were further discussed in detail by members of the Washington staff at local meetings of institutional representatives throughout the Nation. The suggested curtailment was definitely outlined in ESMWT-Misc. 3030, which specified that institutions should confine enrollments to persons who needed training on their current war jobs or for war jobs for which they had assured employment. In addition, the more elementary training previously offered in preemployment courses and in upgrading persons with little technical training and experience was in general discouraged, except to meet immediate urgent needs of war industries.

It soon became evident that some institutions were interpreting ESMWT-Misc. 3030 in such a way that their programs were being curtailed to the point where training needed in war industries was not being offered. Some institutions considered this document as a directive to discontinue elementary courses, "open classes," preemployment classes, or management courses, no matter how urgently they might be needed locally.

In order to obtain more complete information regarding the effects of Misc. 3030 on the operation of the program the Director addressed a letter dated January 15, 1945, to the regional advisers, in which he requested them to ask the institutional representatives in their respective regions the following four questions:

1. Is it felt that restrictions proposed in ESMWT-Misc. 3030 are limiting the program too drastically to insure that needed training will be offered to meet important industrial war needs in our field? If so, please indicate how, giving pertinent examples.
2. Are there war training needs which in your opinion are not being met due to local interpretations of ESMWT-Misc. 3030? If it is felt that this is the case, what can be done to correct this misunderstanding?
3. Do present industrial conditions in your region indicate that institutions should make increased efforts to determine training needs and if necessary enlarge their programs to meet them?
4. Are ESMWT staffs at institutions being reduced to a point where (a) it becomes difficult for them to adequately determine needs for training and (b) to provide the courses found to be urgently needed? If so, what should be done to correct this situation?

At the time of the regional advisers meeting on February 3, 1945, 15 regional advisers had forwarded to the Washington office the replies from institutions in their regions, while 4 regional advisers had submitted their own summaries of replies which had reached them from institutions in their regions. The total number of institutions represented was 136, in 19 regions.

A summary of the replies was presented to the regional advisers and discussed by them. The main points brought out in the discussions were:

1. ESMWT-Misc. 3030 is not a directive, but guidance expressed from a national viewpoint. Local difficulties experienced by a small number of institutions are believed to have arisen from their individual interpretations of the release.
2. The courses listed in ESMWT-Misc. 3030 are representative of the fields in which the Washington staff has had the greatest difficulty in deciding whether or not a proposed course is essential to the war effort.
3. The main difficulties encountered by the Washington staff in approving courses arise from a lack of information. Institutional representatives are urged to supply adequate information on Forms 1, 5, and 8 to give to the Washington staff a correct picture of the reasons for proposing the course.
4. ESMWT is required to concentrate its efforts on war production needs. Proper courses definitely serving these needs will be approved, provided the proposals make it clear that the courses are needed for war production, and that the trainees will make their training immediately useful in war production.
5. Newspaper advertising should be simply to give notice that certain courses will be offered, and to give date and place of registration, and should not be of such type as to suggest an effort on the part of the institution to "whip up a class."

The restrictive controls, combined with institutional interpretations of ESMWT-Misc. 3030, resulted in a marked reduction in the number of

courses offered and in the number of trainees enrolled. The number of preliminary proposals disapproved and withdrawn in the period from July 1 to November 1 was slightly higher in 1944 than it had been in 1943, but in the period from November 1 through January, it was more than four times as great in 1944–45 as during 1943–44. The percentage of proposals cancelled also showed a marked increase after the issuance of Misc. 3030.

Enrollments during the first 4 months of the fiscal year 1944–45 declined 20 percent from the corresponding period of 1943–44, but following the issuance of Misc. 3030 the comparative decline reached 40 percent.

The results of this study demonstrated again that the program was extremely sensitive to controls, a fact which had been kept clearly in mind in connection with every administrative action during the program. Nevertheless, the modification in policy described above resulted in a more drastic reduction than was anticipated and the program was curtailed to a point where it no longer provided the volume of college-level training necessary for required war production.

"AN APPRAISAL OF ESMWT ADMINISTRATIVE CONTROLS"

Under date of February 24, 1945, a report on ESMWT was prepared for the Commissioner to form part of an over-all study of the national defense training programs of the U. S. Office of Education, " . . . looking toward what is considered to be a more thoroughgoing set of controls to insure that the training is being provided where it is most needed in terms of the war effort. . . . together with specific recommendations showing how it is proposed to 'tighten up' the policies and procedures for handling each of the three war training programs."

The report followed the outline shown below:

Part I. General Organization and Operation of ESMWT
Part II. Evaluative Checks on the Program Prior to January 1, 1945
Part III. Present Shortages in ESMWT Fields
Part IV. Recent Tightening of Controls
Part V. The Present Study in Typical Industrial Areas
Part VI. Summary

Part I consisted of a brief resume of the purposes of the program, the methods followed, the main provisions of the contracts with participating institutions, an outline of the provisions for regional coordination and for cooperation with the War Manpower Commission, a brief statement of operating principles and controls, including discussions of methods of determining local needs and of designing courses to meet them, and the general procedures followed by the Washington office staff in considering course proposals from the institutions.

Part II contained brief statements concerning the letters from industries and participating institutions which had been received in the Washington office throughout the life of the program, and brief summaries of the two studies, "A Critical Analysis of ESMWT Courses," and "How Well is the ESMWT Program Serving War Production Training Needs?" which are outlined on pages 131 and 133 of this history.

Part III discussed the critical shortage of engineers and scientists facing the Nation, and the tremendous importance of such men to the war effort. It was pointed out that current enrollment in engineering colleges indicated that very few engineers would be graduated for several years after the close of the war. Also included were statements by the Director of the National Roster of Scientific and Specialized Personnel, by the Director of the Office of Scientific Personnel of the National Research Council, and by Dr. A. H. Compton, dean of the Division of Physical Sciences at the University of Chicago, all bearing on the shortages of engineers and scientists.

It was pointed out that the ESMWT program, while it could not produce fully trained engineers and scientists, could provide some immediate relief and had in fact done so during the war years. It was noted that the 250,000 ESMWT trainees expected during the fiscal year would receive training equivalent in amount to that which would be given to 25,000 regular college students, approximately one-sixth of the number normally enrolled in the colleges in the fields of engineering, science, and management.

Part IV discussed the tightening of controls which had been effected at the beginning of the fiscal year 1944–45 and the effects of the modification in ESMWT policy outlined in the letter of November 15, 1944 (see ch. III, page 34), reaching the conclusion that the new controls had resulted in a marked reduction in the number of courses offered and in the number of trainees enrolled, and that the program had been curtailed to a point where it no longer provided the volume of college-level training necessary for required production.

Part V presented the results of a spot study conducted in six areas, chosen to represent the various War Manpower Commission Labor-Market classifications, to determine how well the ESMWT program was geared to war work and the nature of any possible weaknesses in the system of controls.

The spot study had consisted of a thorough examination of the records of the Washington office, and field visits by members of the Washington staff in each of the areas studied. Teachers, industrial executives, War Manpower Commission officials and trainees were interviewed in an effort to make an objective appraisal of the degree to which the program was fulfilling its responsibilities. A summary of the results of the study is contained in tables C and D.

Table C.—Status of Trainees in Spot-Study Areas

Area	WMC labor market classification	Number of courses	Trainees	
			Number	percent
Allentown, Pa.	II	7	102	3.2
Atlanta, Ga.	IV	9	207	6.5
Boston, Mass.	II	27	770	24.0
Chicago, Ill.	I	47	1,451	45.1
Dallas-Fort Worth, Tex.	III, II	11	276	8.6
Wichita, Kans.	II	10	313	9.7
Total		111	3,218	100.0

Table D.—Status of Trainees

Trainee status	Trainees	
	Number	Percent[1]
1. Trainee engaged in war work	3,127	97.5
2. Trainee employed by establishment engaged in war work	3,140	97.6
3. Course needed for present job or for more responsible job for which trainee is preparing	3,093	96.4
4. Trainee employed in WMC "must" or "essential" establishment	3,025	94.0
5. Trainee not engaged in war work but assured of employment in a specific war establishment where training is needed	38	1.2
6. Other	43	1.3
Summary		
1. Trainee engaged in war work	3,127	97.5
5. Trainee not engaged in war work but assured of employment in war work after training	38	1.2
6. Other	43	1.3
Total	3,218	100.0

[1]Computed on total (3,218).

The conclusions, based on the analysis of records and field visits, were stated in the following language:

1. The courses included in this study of the six areas are "geared to war work" to a high degree. This is demonstrated by:
   (a) The high percentage of the trainees engaged in war work and needing the training in their jobs.
   (b) The high percentage of trainees from "must" and "essential" establishments.
   (c) The proportion of the trainees who are taking the courses on recommendations of their employers.
   (d) The enthusiastic endorsements of representatives of industries being served by the courses.
2. The discovery of a few trainees in some courses who were not directly connected with war production is not regarded as significant for two reasons:
   (a) The number of such trainees was small in all cases. It should be realized that 100 percent efficiency in the selection of individuals for any purpose is not a reasonable operating goal.
   (b) Such a small percentage of trainees in any class does not add to the cost of the course.
3. Institutional representatives should continue to use the "must" and "essential" lists and should give priority to the college-level training needs of "must" establishments, but it is very important that the needs of other establishments be served.

4. The program is unable to serve all college-level training needs, especially in the small war production establishments. To remedy this condition, it would be necessary to do two things:

(a) Enlarge and perfect the system by which needs of war industries are discovered and communicated to ESMWT representatives.

(b) Find additional ways to provide training for establishments with only a few persons needing training. This may be done by providing courses that will serve employees of other small industrial concerns with war contracts. This requires more ESMWT personnel than is now available for this purpose.

Part VI presented the outlines of the first five parts in greatly condensed form. The summaries of parts IV and V were:

Part IV.—The tightening of controls instituted during the current fiscal year has resulted in a marked reduction in the number of courses offered and in the number of trainees enrolled. The tighter controls have limited the program so drastically that in many localities, it is no longer meeting important industrial war needs. They have caused confusion and uncertainty as to the future of the program in some participating institutions and the industries they serve.

Part V.—The ESMWT program as represented by the six areas included in the study is closely "geared to war work." This is made evident by two findings, among others, namely that 97.5 percent of all trainees are employed in war work and 94.0 percent are in "must" and "essential" establishments.

The discovery of a few trainees in some courses who were not directly connected with war work, or where such connection was doubtful, is not regarded as significant.

While priority should be given to the college-level training needs of "must" establishments, it is important that the needs of other war industries be served to as great a degree as permitted by facilities of this program.

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